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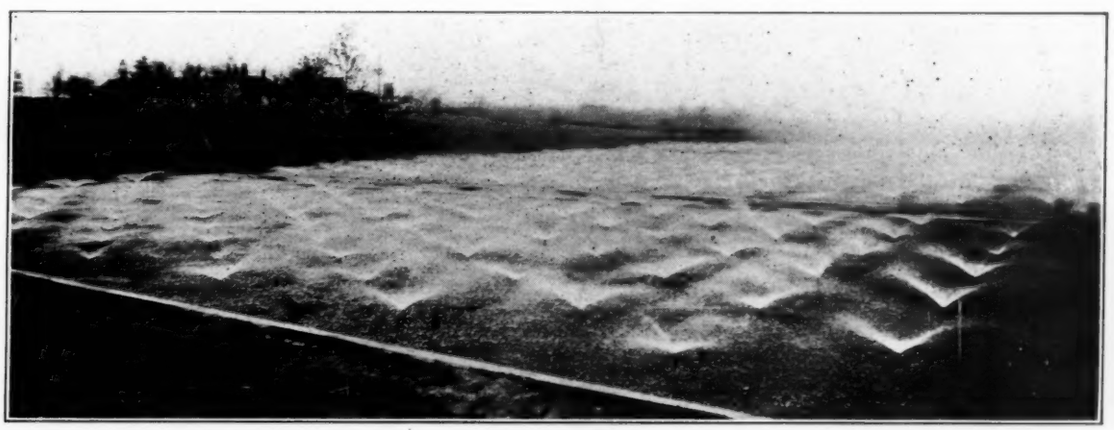

SPRINKLING FILTER OF LEXINGTON, KY., SEWAGE TREATMENT PLANT
This plant, which contains several notable features and is operated with unusual care, is described in this issue.

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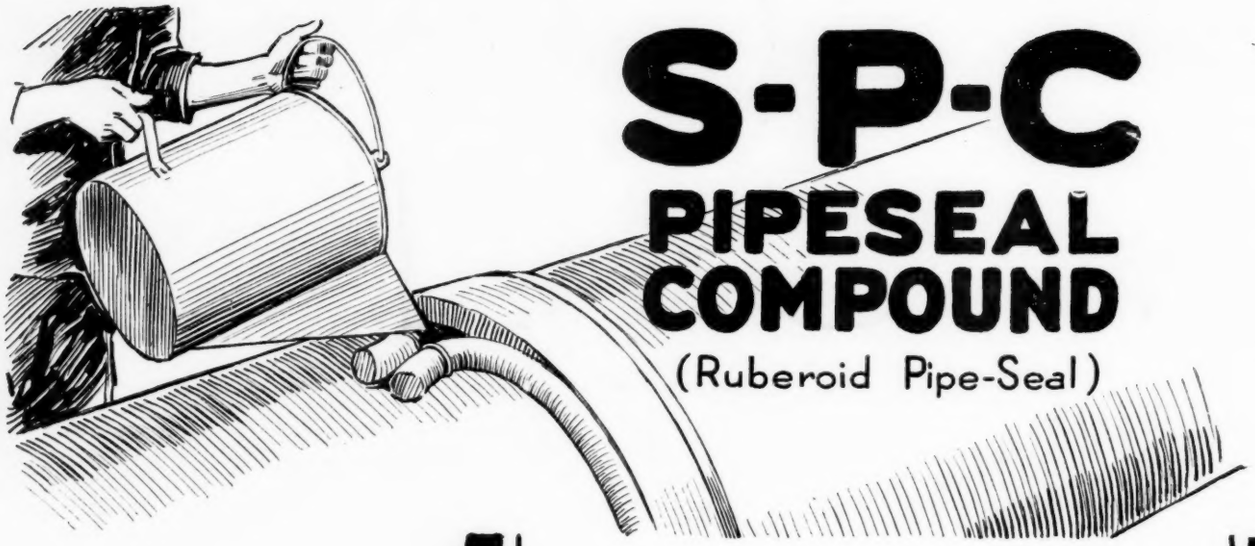

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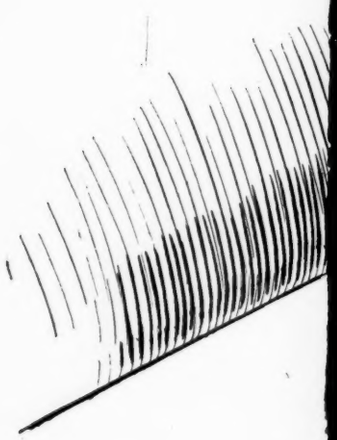

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Sewage Treatment at Lexington

Grit chambers, Imhoff tanks, sludge beds, dosing tanks, sprinkling filters and secondary tanks. Inverted siphon under railroad tracks. Methods and cost of operation.

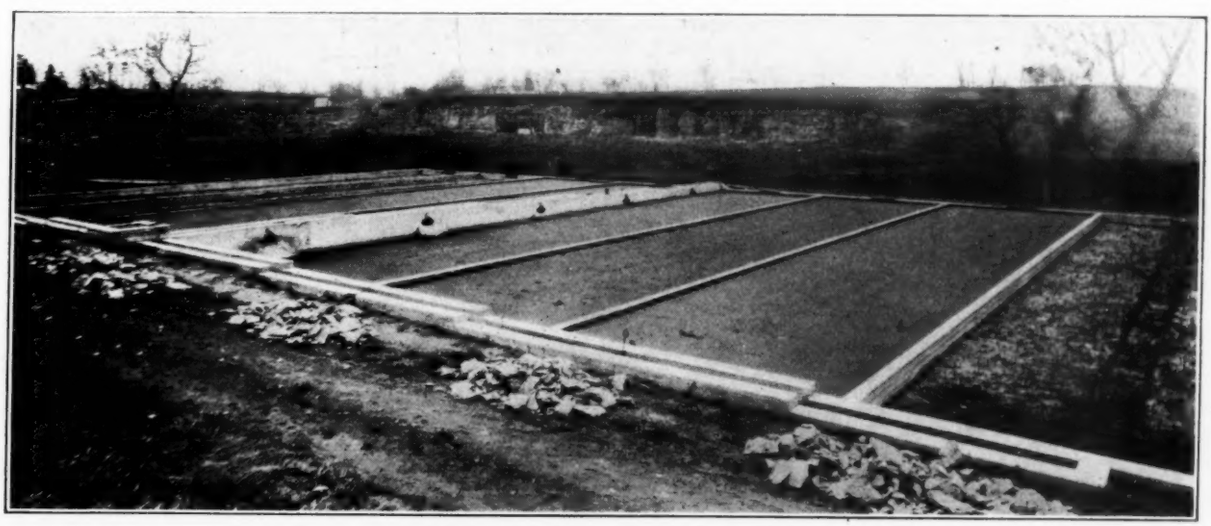
The house sewage of Lexington, Ky., is collected by a system divided into three main units, known as the southern, central and northern. These serve approximately 3,500 acres containing a population of 45,000 and carry an average daily flow of 3,000,000 gallons. The general flow is westward and the three units combine in a 39-inch outfall sewer at the western city limits. This outfall sewer is 5,300 feet long and has a uniform grade of 1.3 feet in 1,000.

At the end of this outfall sewer is a sewage treatment plant which was built about three years ago. It is located on the city farm about a mile west of the town, which farm also contains the city jail and the city rock crushing plant. The sewage plant is located on the bank of a creek and the elevation of the end of the outfall sewer here is 26 feet above the creek.

The plant is about 200 feet south of and 10 feet higher than the tracks of the L. & N. Railroad. As the outfall crosses these tracks it was necessary to pass under them by use of an inverted siphon. This siphon is constructed of two 18-inch cast-iron pipe which can be operated separately or together. A few feet south of the tracks the siphon pipes rise vertically and discharge into an open channel constructed of concrete which is 15 feet above the surface, the channel being 4 feet deep and 3 feet wide and 350 feet long. The siphon pipes continue at the grade of their lowest level to form a blow-off into the creek for use in emergencies. Where they pass under the railroad tracks the bottoms of the pipes are 9 feet below the rail.

THE TREATMENT PLANT

The plant consists of grit chambers, Imhoff tanks, sludge beds, dosing tanks, filter beds and secondary tanks. There are three grit chambers constructed for operation separately or together; two Imhoff tanks each divided into two units, with two sludge chambers in each unit. There are two dosing tanks equipped with Miller flushing apparatus, each tank divided into two chambers, each chamber having a capacity for discharging about 11,000 gallons. The open channel passes an area provided for future settling tanks and



GENERAL VIEW OF SLUDGE BEDS

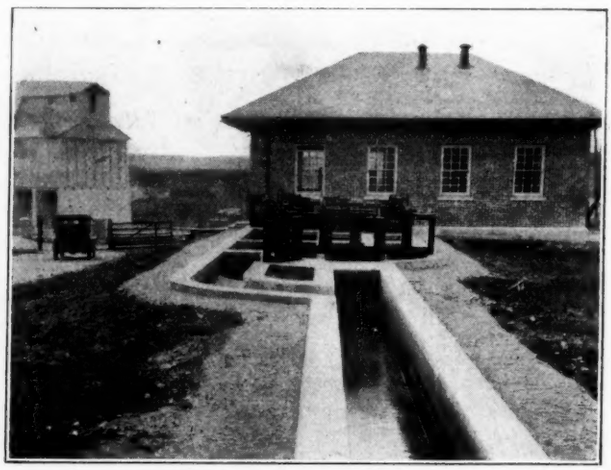
Portable track for sludge cars at extreme right. Trestle for sludge cars at left background.

there is also area for additional sludge drying beds and sprinkling filters.

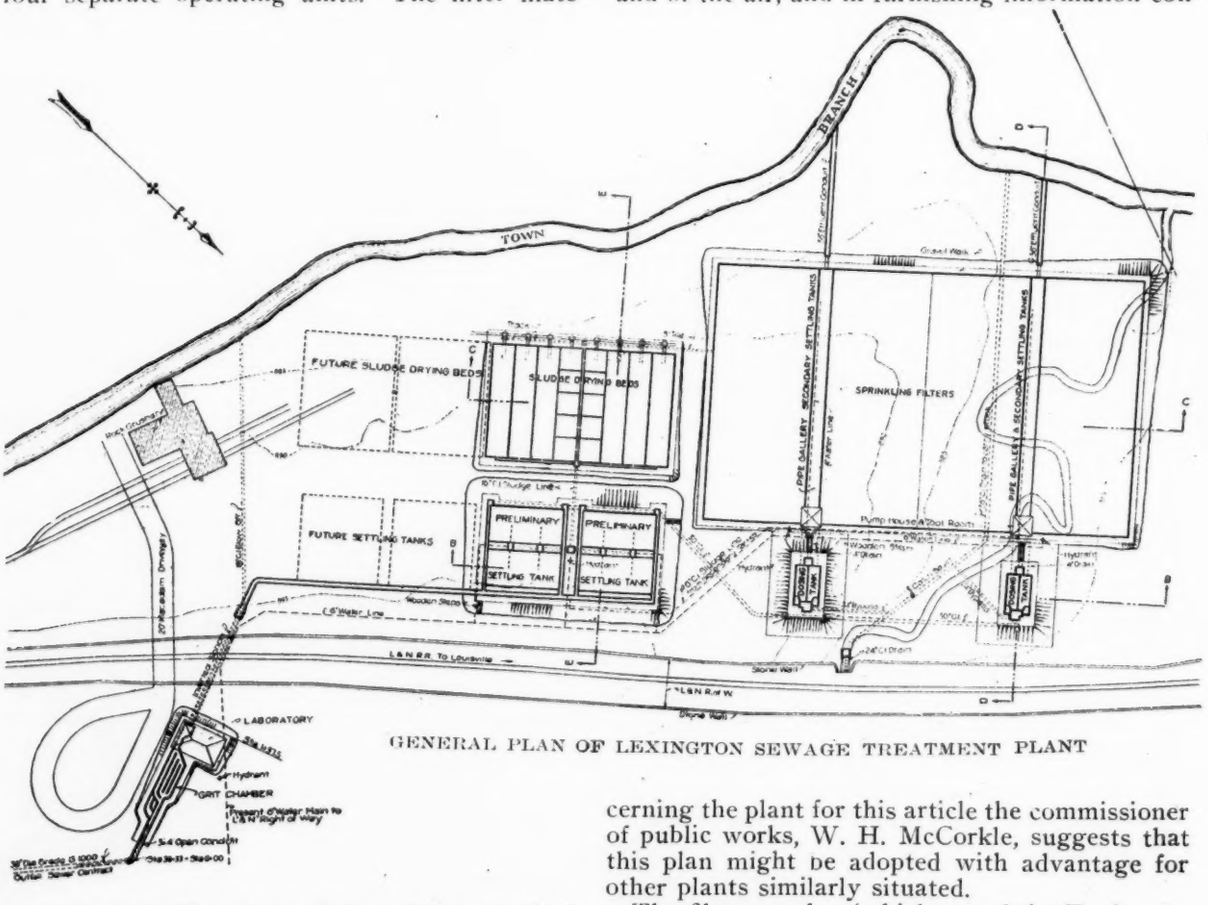
Just above the intake end of the inverted siphon are three grit chambers provided with screens and equipped with electrically operated pumps for cleaning them. Adjoining these and over the entrance to the inverted siphon is a laboratory used for controlling the operation of the plant. The screen just ahead of the grit chambers is constructed of ⅜-inch by 2-inch bars 8 feet long spaced two inches apart, making an angle of about 30 degrees with the horizontal. Each grit chamber contains in the bottom a basin depressed 15 inches below the bottom of the outlet and 25 to 30 feet long. Below the bottom of this depression is a further depression filled with graded broken stone covering a line of 6-inch open-joint drain pipe, the center of which is 15 inches below the bottom of the depressed channel.

The Imhoff tanks are placed with their direction of flow parallel to the inlet channel. From this channel a branch inlet passes down each end of the tanks so as to provide for reversing the direction of the flow.

The filter beds contain two acres divided into four separate operating units. The filter material is six feet deep, four of these being crushed native limestone and the two upper feet being crushed Georgia granite. In constructing the filter beds the city was confronted with the alternative of using local limestone or paying about 60 per cent more for granite for the filtering material. It was finally decided to use the local limestone for the lower two-thirds of the material and the imported granite for the upper one-third. This kept the limestone beyond the action of freezing and of the air, and in furnishing information concerning the plant for this article the commissioner of public works, W. H. McCorkle, suggests that this plan might be adopted with advantage for other plants similarly situated.



OUTFALL SEWER AND GRIT CHAMBERS
Screen just above grit chambers. By-pass at left. Laboratory building in rear. City stone crusher at left rear.



GENERAL PLAN OF LEXINGTON SEWAGE TREATMENT PLANT

The filter nozzles (which are of the Taylor design) are mounted on rising pipes of two-inch galvanized iron, these rising pipes or nipples being screwed into bosses in the main distributor pipes, which pipes are imbedded in the stone with their axis 9 inches below the surface of the filter, the orifice of the nozzle being 4 inches above the

filter surface. The main distributors are from 20-inch to 12-inch, while the lateral distributors are 6-inch "universal" pipe. The underdrainage system consists of 6-inch half tile completely covering the bottom of the filter.

The only pumping required is an electrically operated sludge pump for removing the sludge collecting in the secondary settling tanks, which tanks are located between the sprinkling filters and under the pipe gallery, each tank being about 220 feet long and 10 feet wide and divided into 16 hopper bottoms, each with its suction pipe resting on an open footing for removing the sludge. Each hopper bottom is 10 feet square at the top and 8 feet deep. The sludge from the settling tanks is pumped back into the Imhoff tanks, while the effluent passes into the creek.

The sludge bed area is made up of six separate beds each 20 feet by 105 feet. A 24-inch gage railway runs down the middle of each bed to a main track just outside the ends of the beds, there being a turntable at the junction of each branch with the main. This main track is continued beyond the beds onto a low trestle to facilitate dumping the sludge into carts for hauling away.

CONCRETE CHANNEL LEADING TO SETTLING TANKS
Inverted siphon, after passing under tracks, discharges into channel at the left end. Valves of settling tanks are seen at the right.

OPERATION OF PLANT

The Lexington plant is perhaps as efficient a one in its operation as any in the country, and employs the most up-to-date appliances which have been proved to be effective. By passing under one railroad by an inverted siphon it is possible to reach the plant with sufficient head above the creek to avoid pumping. Very little labor is necessary for its operation and for the upkeep of the grounds, which the city is endeavoring to make attractive by shrubbery and other planting.

During the two years and six months of operation the upkeep of the plant has consisted of cleaning the grit chambers once a month, skimming and cleaning the surface of the Imhoff tanks about three times a week, cleaning the secondary hoppers about three times a year, removing the sludge at intervals averaging about one bed a week, and hauling away and scattering about half the sludge, the other half being taken by farmers.

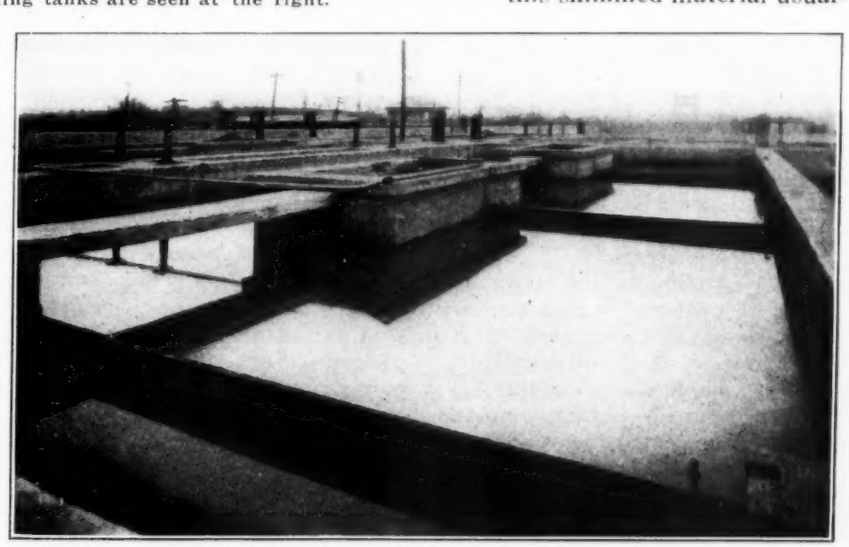
The annual cost of upkeep and maintenance of the plant and grounds is as follows:

Superintendent	$1,800
Chemist	900
Watchman	780
Power, light and water	216
Telephone	53
Team, wagon and incidentals	500
Total	$4,249

In addition, two laborers from the prison are employed for which no charge is made and which are not included in the cost above.

An excellent feature of the plant, which is omitted from some plants apparently from oversight and from others because of the absence of any water supply in the vicinity, is a complete system of water supply with connections for attaching a hose at every part of the plant. This permits of easy and convenient cleaning and washing down of the walls, breaking down scum in the Imhoff tanks, loosening sludge and other purposes.

In breaking down the scum on the surface of the tanks about every three days, the surface is first sprinkled to settle as much of the scum as possible and that which does not settle is then skimmed off and thrown into the gas vents, this skimmed material usual-



IMHOFF SETTLING TANKS IN SERVICE
On chimney in foreground may be seen water pipe. In chimney is seen scum nearly to the top.

ly consisting of corks, matches and other light floating matters. The only reason for cleaning the surface of the tanks as often as this is that of cleanliness and appearance and to provide better opportunity for air action.

Each discharge of 11,000 gallons from a chamber of the dosing tanks is distributed over one acre, and the discharges occur, on an average, seven times an hour and continue for two minutes, no sewage being sprinkled over the bed during the remainder of each interval.

The nozzles on the sprinkling filter do not clog readily and are easily removed and cleaned. One man working for four hours a week can keep clean the nozzles of two acres of filter and maintain satisfactory operation. He goes over the beds about twice a week, removing and cleaning all sprinkler heads that are not perfectly free of stopage.

Up to date about 50 per cent of the sludge has been removed by farmers. The farmer can drive his wagon under or alongside of the trestle leading from the sludge bed and the sludge cars run onto the trestle can be dumped directly into his wagon. The sludge not so removed has been used for fertilizing the city farm and the area around the plant. The results reported by different farmers and the superintendent of the plant show that the crops of corn, tobacco, oats and potatoes fertilized by the sludge are much superior in yield and in quality to those grown on land not so fertilized. So far these are the only crops that have been fertilized by sludge. The farmers using the sludge fork it onto the land directly from the wagons in which they receive it at the plant. The farm contains a number of quarry sites which can be filled with sludge and which are estimated to have capacity for receiving sludge for sixty years to come. The city works these quarries and one of the illustrations shows the city rock crusher and stone bins.

Kansas City Water Supply

A report on improvement and extension of the water supply of Kansas City, Mo., was presented to the Board of Fire and Water Commissioners of that city on December 31st last. It recommended construction estimated to cost $18,000,000 based on 1920 prices (although on a pre-war basis the cost would probably have been less than half of this), and that a commission be appointed for carrying out the work as has been done in New York, Cincinnati and elsewhere.

On February 21st the mayor appointed a committee of 25 men and women representing every phase of business and civic life in Kansas City as a committee to work out details of the procedure for securing the new water supply. The main problems presented for its solution were the character of the bonds to be issued, the amount of bonds, the rate of interest which they should bear, the charter amendments which would be necessary and the holding of a bond election. The first meeting of the committee was held the day following. Previous to this a committee of four had been named at a joint meeting of the civic organizations which was responsible for the appointment of the committee of 25, and the latter committee requested the committee of four to draft a plan of organization and appoint from its membership subcommittees to investigate the various phases of the subject.

This plan seems to give every opportunity for carrying on the work with the full confidence of the public and so far politics has apparently played no part in these appointments.

The consulting engineers are Fuller & McClintock, and they state that the water supply condition of the city is serious in that it is already nearly at the limit of its present supply, while it would require 4 or 5 years and possibly 6 to build the new supply. Meantime it will be necessary to impress upon all citizens the need of conserving supply and cutting down consumption to a minimum.

Details of the recommendations of the consulting engineers will be given later.

Some Recent Highway Costs

Several of the states have already received bids for highway construction, although the number is not so great as was hoped for so late in the spring as this. The State Highway Commissioner of Pennsylvania has announced that all bids received by him were too high and should be rejected, and a few days later the Illinois Division of Highways made a similar announcement. Bids were received by Massachusetts on March 1st for two concrete roads and a bituminous macadam road. In the former the chief item was of course the concrete and the bids on this ranged from $15.00 to $16.25 per cubic yard for the concrete surface, the amount of such surface being 4,250 cubic yards in one case and 2,310 cubic yards in the other. This indicates close bidding. Two of the firms bid on both contracts, one bidding 50 cents more on the second than on the first and the other bidding 92 cents higher on the second contract.

The surface material of the bituminous macadam road comprised 2670 tons of broken stone and 23,550 gallons of bituminous material. The bids for the broken stone were $5.00, $5.10 and $5.50 by the three bidders and for the bituminous material were 35 cents, 25 cents and 29 cents, respectively.

In Wisconsin, bids had been received for two dirt roads and one with alternative bids on concrete and bituminous macadam. In the case of the earth roads the largest items were of course earth excavation and embankments, and as the details are not known, the reasonableness of the prices cannot be judged. However, the bids for earth excavation on one contract ranged from 60 cents to 72 cents, and on the other from 65 cents to 85 cents. In each of these the contract was awarded to the lowest bidder. In the case of the surfaced road, 18-foot concrete surfacing bids varied from $2.43 to $2.83, and for 18-foot bituminous macadam two bids were received for $2.79 and $2.85, respectively. Of the two contractors bidding on both surfaces, one bid a total of $123,116 on concrete and $102,461 on bituminous macadam, the other bid $137,153 on concrete and $104,229 on bituminous macadam.

At Lebanon, Pa., on March 3d, a bid was let for

concrete at $16.50 a cubic yard; or $3.07 per square yard including excavation of old macadam and pavement 6 inches thick mixed 1:1½:3 and with 25 pounds of mesh reinforcement per 100 square feet. Also one for bitulithic on a 5-inch concrete base mixed 1:3:6 and excavation of old concrete for $3.82 a square yard, the concrete being $11.90 a cubic yard and the bitulithic $1.75 a square yard.

Lowering Water Main with Trench Machine

The water department of Springfield, Mass., last year lowered a 30-inch water main 12 to 18 inches for a length of about 700 feet in St. James boulevard because of a change made in the grade of the street since the pipe was laid. In this work it used a Parsons trench machine. This excavator was used to dig a trench 2 feet wide on one side of the pipe and down to a depth to which the pipe was to be lowered. At the same time 6 men with shovels excavated a trench to similar depth on the other side of the pipe, throwing the dirt over into the buckets of the excavator. The men also removed the earth from under the pipe, except that columns were left to support it at intervals of a few feet. With the entire length in this condition, the men gradually reduced the size of these earth columns, permitting the pipe to lower gradually, which it did without assistance owing to the weight of the pipe and contained water. The entire work was finished in a day and a half and the trench was refilled in a short time afterward by the use of a backfiller. H. M. King, assistant superintendent of the water department, said that it would have required 40 to 50 men to have done the work entirely by hand labor.

This excavator was put into service by the department last May and first laid a mile of 16-inch pipe, followed by removal of a half mile of 6-inch pipe and the laying of 2 miles of 8-inch. In laying pipe with this trencher a gang of 8 to 12 men is used, most of them for rolling the pipe, lowering it into the trench, digging bell holes, etc. About 35 men are ordinarily employed for similar work where the machine is not used.

An Automatic Release Sling

For the construction of storage reservoirs on the Yakima projects, Washington, bundles of round timber are dragged along the surface of the ground by a cable operated by a hoisting engine and attached to a wire rope sling passed around the bundle of logs.

The sling has a loop at each end and is fitted with an automatic releasing device that enables it to free itself when the tension is released and then to be hauled out from under the logs by the hoisting engine pulling in the slack of the main cable.

A snatch block that has a hook attached, engages the sling rope and is free to move from end to end of it but cannot pass over the loops at both ends. In service one loop of the sling is attached to the hook on the end of the hauling cable and the other end is passed around the bundle of logs and the loop on it engages the hook on the snatch block forming an adjustible loop or bight that encircles the logs. Winding up on the drum of the hoisting engine tightens the hauling cable, pulls the bight up snug against the timber and holds it there while the timber is dragged to position.

When the hauling rope is slacked off the spring in the sling rope throws it out of engagement with the hook on the hauling rope and when the latter is dragged back by the tail line attached to its main hook another short line attached to this hook and also attached to the hook on the snatch block, pulls the latter and the sling rope free of the logs and returns it to the hoisting engine.

This device enables a large strain to be put on the sling rope to release it and saves much time and trouble otherwise necessary for freeing the rope by hand. A similar arrangement might often be devised for detaching sling ropes in inaccessible positions or under difficult conditions for various kinds of construction operations.

Water Meter Maintenance

Itemized costs of reading and upkeep in Terre Haute.

In a round table discussion on the subject of water meters held by the Indiana Sanitary and Water Supply Association, Dow R. Gwinn, president of the Terre Haute Water Works Co., described the methods employed by his company, among them the following:

All meters are read monthly and bills rendered covering that period. The cost of repairing, testing and maintaining meters during the previous year was $522.61 for material and $1,721 for labor; 7,700 meters were in use, giving the average cost per meter in use as about .29 cents.

The expense on consumers' premises consisted of $304.25 for inspecting plumbing, $935.91 for investigating large bills and services, $2,694.62 for turning off and on, $20.20 for changing meters for testing, $479.45 for removing and setting meters; an average of 56 cents per meter.

The cost of reading meters was $2,600, an average of 34 cents per meter per year or a little less than 3 cents per month. The cost of delivering bills averaged 16.6 cents per customer per year, or 1.4 cents per month. The cost of office and clerks making out bills, receiving payments, etc., averaged 69 cents per consumer. The cost of repairing leaks and changing service connections from main to curb was $546 for material and $711 for labor, an average cost of 15.9 cents per service.

This gives a total of about $2.20 per meter per year for cost of maintenance and repairs of meters and services. Ninety-seven per cent of the services are metered and the minimum monthly rate for ⅝-inch meters was 75 cents, for which the consumer is allowed 3,000 gallons during the month. Omitting industrial and railroad consumers, the average payment per month was $1.27. The company is required to furnish and maintain the service pipe from the main to the curb and also to furnish and maintain the meter. Mr. Gwinn maintained that with such low bills

it is impossible for water works to make any profit under present conditions.

He stated that the experience of his company was that large meters should be tested once every year and that the saving to the company in correcting slow meters will far offset the cost of overhauling and testing. All large meters appear to run a little slow after having been in service for a year, most of them 5 to 10 per cent and some as high as 15 per cent. Smaller meters, 5/8-inch and 3/4-inch, should be tested about once in seven years. Every water department having 500 or more meters should be provided with a good meter testing outfit.

He believed that monthly reading of meters is advisable, even though the bills are rendered by-monthly or quarterly; his reason being that in this way leaks and excessive meter registration could be detected before the bill had become too large, and the consumer was less apt to feel that he was being cheated by the company if notified as soon as possible of the excessive consumption.

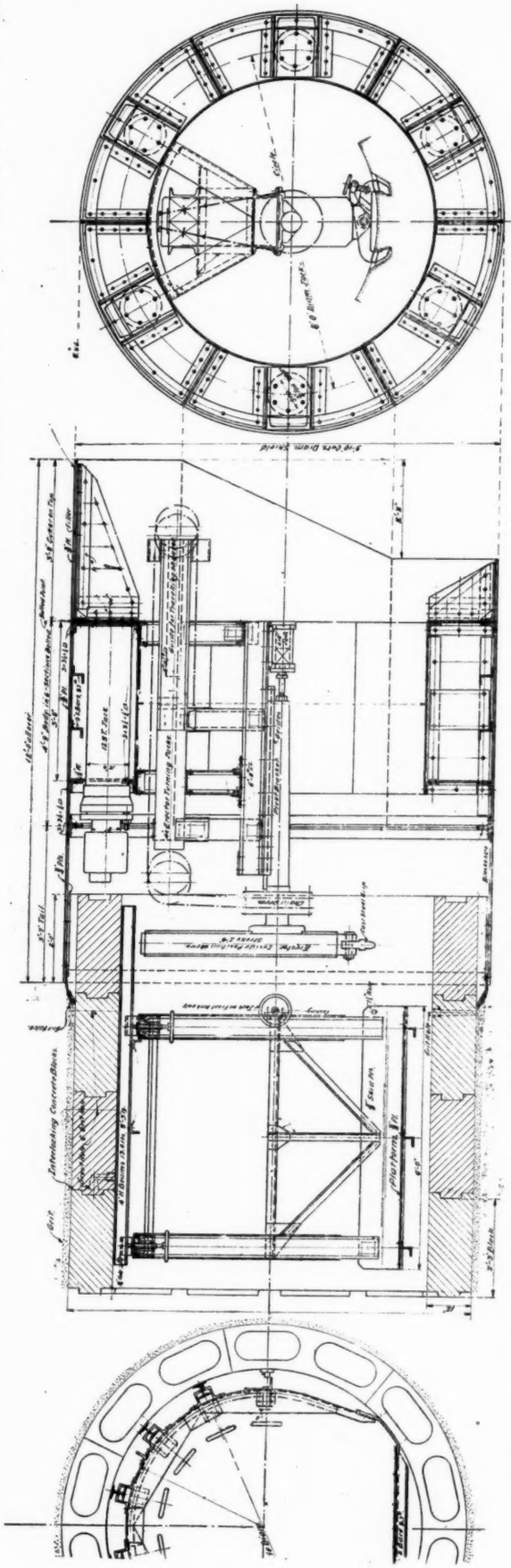
Linden Street Sewer Tunnel*

Method of shield excavation and driving, alignment and adjustment. Erection of concrete lining blocks. Adjustable supporting traveler. Backfilling behind shield tail. Grouting joints and backfill. Rapid progress and accuracy.

Construction operations were commenced by the installation of the contractor's surface plant and the sinking of one of the end shafts, about 30 feet deep. At the foot of this was installed the excavation shield 9 feet 10 inches in exterior diameter and 12 feet long over-all, which weighs about 13 tons and was built by the American Bridge Company. It is made with a 3/4-inch shell plate reinforced at both ends, and has a heavy annular vertical diaphragm located 3 feet 8 inches from the forward end and heavily braced to receive the thrust of the pushing jacks. A similar ring, perforated to receive and support the inner ends of the jack cylinders, is located 3 feet 8 inches behind the first ring and the inner flanges of both rings are connected by a cylindrical 1/2-inch plate forming the inner wall of the annular chamber in which the jacks are seated. The tail of the shield terminals with a flexible conical rubber and canvas apron 1/4 inch thick, that engages the exterior of the tunnel lining and forms a stop to exclude earth, sand and grit from the shield.

The shield has a clearance of 2 inches on all sides of the concrete lining. It is equipped with seven 125-ton hydraulic pushing jacks made by the Watson-Stillman Company. The jacks have

*Continued from page 219.



TUNNEL AT HEADING, SHOWING ARRANGEMENT AND DETAILS OF CONCRETE BLOCK LINING, EXTERIOR PACKING, SHIELD, JACKS, ERECTOR AND BLOCK ASSEMBLING TRAVELER

an 8-inch piston and 32-inch stroke, and are usually operated at 1,500 to 1,800 pounds pressure. They react against heavy oak cushion pieces placed on the face of the last erected ring of the lining blocks, and usually drive the shield forward 27 inches in about 5 minutes.

SEGMENTAL BLOCK ERECTOR

Suspended from the roof of the shield is a 3-ton erector for assembling the segmental roof blocks, which are about 4 feet long and weigh about 1,500 pounds each.

The erector, made by the Watson-Stillman Company, has a revolving radial arm carrying an adjustable grip that engages and is locked into the grip holes in each block and support it until it is in place. The erector has a rigid structural steel framework that carries the radial arm and the operating jack for revolving the arm and another for moving it longitudinally. The latter is of rectangular cross section made to fit the framework. The erector jacks, like those in the shield, are operated by a pressure pump on the surface which has a nominal capacity for 5,000 pounds pressure, only a fraction of which is required in this work.

An erection traveler follows immediately in the rear of the shield and supports the upper segment of each successive lining ring until the ring is completed, when the segments are self-supporting. It consists of a steel cradle and floor platform 6 feet long that takes bearing on the invert each side of the center line and has riveted to it a horseshoe shape steel transverse rib curved to a radius of 3 feet 3 inches. Each ring carries a jack at the springing line and at intermediate points, a total of eight screw jacks for the support and adjustment of six horizontal longitudinal I-beams, and two bearing castings for the support and adjustment of the segmental blocks.

The forward rib is located in the plane of the last completed ring of tunnel lining and the rear rib in the plane of the second ring in the rear or the third from the end, and the screws are set in the two ribs so as to force the I-beams into contact with the soffit of the lining, with the forward ends projecting far enough beyond the last assembled ring to afford complete support for the blocks as placed by the erector. This traveler is light and convenient, easily handled, affords very satisfactory support for the blocks, and permits passage through it to the shield and heading. It weighs about 3,000 pounds and was built by the American Bridge Company.

EXCAVATING, SHORING AND ERECTING

The excavation amounts to about 2.7 cubic yards per linear foot of tunnel and so far has consisted of about 90 per cent sharp sand and 10 per cent clay. The sand is all removed by hand by men working at a vertical face supported by horizontal breast boards braced back to the shield. Generally it will stand for a few inches of exposed vertical face, and at the top the excavation is made under the protection of thin poling boards about 6 inches wide and 2 feet long which are supported at the rear end on the cutting edge of the shield and at the forward end on vertical struts. In clay the excavation is made with mattocks. A small amount of water is encountered in the bottom of the tunnel which usually rises to a height of about 24 inches behind the dam formed by the muck shoveled back from the heading, and is removed in five minutes by a 3-inch centrifugal pump and a pulsometer just previous to the erection of a ring of segmental blocks.

As soon as the excavation has been completed for 2 feet 3 inches in advance of the shield, the latter is shoved forward in about 5 minutes by its jacks, the latter are retracted and the segmental blocks, brought in on flat cars on the 24-inch gauge service track laid on the tunnel invert, are assembled in position from the invert up by the erector, each block being located and interlocked with the preceding ring by the projections on the rear end that fit the recesses in the finished ring.

While the ring is being assembled, four men in the forward part of the shield excavate in advance and throw the muck back through the shield to a pile on the floor of the invert just in the rear of the traveler. From this pile it is shoveled into buckets and pushed by hand on flat cars to the foot of the shaft, where it is hoisted by a derrick and dumped to either of four elevated storage bins of 3 yards capacity that have double-flap hinged bottoms through which the contents of the bins are instantaneously discharged into trucks by which it is hauled about ¾ of a mile and dumped for fill on low ground.

PLACING THE GRIT PACKING

As soon as each successive ring has been completely assembled, short nipples are screwed into the grit holes in the intrados of the blocks. A 2-inch hose is connected to the nipples in the grit holes and they are first blown out with air at 80 pounds pressure, after which ⅛-inch washed and screened grit or gravel is forced through them under the same air pressure until no more can enter. The pipes are then shifted to other holes and the operation repeated.

Rods are then inserted through the grit holes and moved about to loosen the grit to enable the maximum amount to be forced in, and the hose connections are again made on these nipples, air is forced in and then more grit until the holes are filled solid. From 5 to 9 cubic feet of grit is required for each linear foot of tunnel. It is deposited in a substantially uniform layer about 3 inches thick all around the circumference of the concrete lining.

After the grit has been placed and the joints pointed up with cement mortar, grout under a pressure of about 80 pounds is forced into the joints and whatever voids there are outside the lining. The nipples are then removed and the threaded holes in the concrete blocks are pointed with cement mortar, as are the grip holes with which the blocks were handled by the erector.

ALIGNMENT ADJUSTMENT

The alignment of the tunnel is accomplished by means of six radial set screws inserted through the shield shell at equi-distant points below the spring line. These screws give 2-inch adjustment on all sides of the shield and are followed up by shim plates from ⅛ inch to ½ inch in thickness that give bearing for the segment blocks up to the spring

line and permit a deflection or correction up to 2 inches in any direction from the axis of the tunnel. They are very easily and quickly operated from the interior of the shield and enable the tunnel to be driven with such accuracy that the deviation from line or grade in 500 feet is less than ½ inch.

The work is carried on continuously by three 8-hour shifts, each of which averages three complete rings or 6 feet 9 inches progress, making a little more than 20 feet advance daily. During the month of December the tunnel was driven 184 feet notwithstanding the delays and interruptions incident to the installation of the plant and training the men to its operation. In January it was driven 390 feet and the week from January 28 to February 5 it was driven 116 feet. On February 6, when the notes for this article were taken, the tunnel had been driven 680 feet; subsequently it reached the foot of the intermediate shaft and the shield was revolved 90 degrees horizontally and pointed toward the second intermediate shaft.

The work is executed with a force of 16 men in each shift and an extra 9-man floating gang during the day shift.

Besides the equipment already mentioned, the plant installed includes one Ingersoll-Rand electric air compressor with a capacity of 350 cubic feet of free air per minute at 100 pounds pressure, one 25-gallon hydraulic pump with a capacity of 5,000 pounds pressure built by the Watson-Stillman Company, a derrick, and a two-drum Lidgerwood hoisting engine. The work is being executed under the direction of Innis O'Rourke, general superintendent, and Harry Redwood, superintendent in charge.

Municipal Partnership in Water Supply

Decatur, Ill., has partially effected an unusual business arrangement for increasing its water supply, entering into a partnership with a company organized for this especial purpose.

The city had planned to impound water in the Sangamon river by constructing a dam south of the city and the dam is now under construction. The city, however, had neither funds nor credit necessary for acquiring the lands that would be flooded by the dam or for the raising of bridges and altering of roads that would be required if a reservoir were formed in the river valley.

In this emergency an arrangement was evolved by which Decatur citizens have organized a "Water Supply Company" for the purpose of furnishing the necessary funds and otherwise assisting in securing for the city the facilities necessary for increasing its supply. An ordinance looking to the formation of a contract with this company was presented to the City Council on February 21st, but the arrangement could not be finally perfected by law until seventeen days later.

Under this arrangement the water company is to acquire in its own name the land which would be flooded, clear the land so as to be suitable for flooding, defend any suits and pay any judgments on account of backing up the water, and pay the cost of altering roads and bridges; the total expenditures not to exceed $1,000,000. The city agrees to pay the water company $35,000 on or before May 1, 1921, to complete the dam and intake and maintain same, and to pump the supply into and through the distribution system and sell it to consumers at reasonable rates, the rates collected to be for the joint account of the city and the water supply company. The sums accruing from rents are to be paid out only upon vouchers or warrants issued by officers of the city and company. The city will be paid each month its operating expenses for the previous month and the remainder will be divided between the company and the city in the proportion of 90 per cent to the company and 10 per cent to the city.

The contract is to run for 30 years, except that it can be terminated by the company on 30 days notice at any time after January 1, 1923, if the returns paid to the company during the previous year shall not have amounted to at least $135,000, unless the city shall pay the company the deficit within 30 days. If the contract is terminated or is for any reason declared void, the city must empty the reservoir and remove the dam or take such other action as may be necessary to return the river to its normal level. If the contract is declared void by courts, the company and city will continue an arrangement by 30-day periods, the city paying to the company 8 cents a thousand gallons on all water pumped, and these 30-day periods may be continued for not to exceed 30 years from the date of the contract.

At any time within this 30-year period the city can purchase the holdings of the company; the sum to be paid being sufficient to retire the outstanding obligations of the company, including its preferred stock, at its original par value, together with 7 per cent interest per annum on the outstanding capital stock from the date of its issue less any dividends already paid, and to pay the expenses of winding up the affairs of the company, including $1,000 to be distributed among the holders of the common stock; the company for this sum to turn over to the city, free of all liens, all its property and assets save a sufficient amount to pay its obligations and retire its capital stock.

Civic Tour to Europe

A tour is being planned to visit Europe next summer under the leadership of Dr. John Nolen, town and city planner, called a civic tour, with a view of studying the civic, economic and industrial conditions of England, Belgium, Germany, Austria, Italy and other countries. It will start June 7 and the party will break up in Paris on August 3 to return at the convenience of each individual. The rate from New York to the disbanding in Paris on August 3 will be $940, not including tips or any extras or passport expenses. Further information can be obtained from J. L. Crane, Robinson Hall, Harvard University, Cambridge, Mass.

Atlanta Votes $8,850,000 Improvement Bonds

Atlanta, Ga., early in March voted almost unanimously (21,710 to 513) for a bond issue of $8,850,000 for public improvements. Of this $4,000,000 is for schools, $2,850,000 for water works improvement, $1,250,000 for sewer extensions and $750,000 for a viaduct.

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Advantage of Precast Tunnel Lining

An interesting demonstration of the manufacture and use of precast segmental concrete blocks for tunnel lining is afforded by the work now in progress on the construction of the 7-foot 3-inch Linden avenue sewer tunnel near New York City described in this issue. Blocks 12 inches thick having interlocking grouted joints are installed so rapidly and accurately that the tunnel is advanced about 20 feet per day and deviates less than ½-inch from grade or alignment.

The blocks are cast at the site of any required strength, do not need the costly machining necessary for iron segments, require no additional lining and provide a completely finished tunnel as soon as they are set, pointed and grouted, all of which may be completed in a single day. They eliminate the use of temporary lining, develop full strength as soon as assembled, and obviate all necessity for temporary supports, forms, or interior concreting apparatus and operations that so much obstruct tunnel space.

Nearly all tunnels require substantial linings to support the roof, to resist external pressures from fluid, semi-fluid or plastic materials, to exclude water, or to provide for a smooth and uniform interior finish, or for all of these reasons.

On account of their strength and convenience and particularly because of their adaptability to use with shield excavators, segmental cast-iron linings have been extensively used, particularly in sub-aqueous tunnels. They are however very costly, may be seriously delayed in manufacture and transportation, and require an interior lining that is applied slowly and with difficulty.

Within recent years segmental concrete blocks have been designed to replace cast-iron lining blocks and have proved successful and satisfactory on several important jobs, notably the Mt. Royal tunnel in dry rock and earth excavation in Montreal, a sub-aqueous Ford tunnel near Detroit, and the Linden Street tunnel.

The tunneling operations are essentially the same as for the cast iron lining. The slow and expensive finishing of construction joints and the large number of joint bolts required for cast iron linings are eliminated.

The principal advantages of the concrete blocks themselves are that they are made when required, at the site, largely with local material; do not require skilled labor for their manufacture, and develop their ultimate strength as soon as assembled in position requiring no additional lining. They are handled by an ordinary or modified type of tunnel erector and form a watertight structure of excellent appearance and great strength. Under favorable conditions they need no reinforcement or costly joint connections, but when necessary can be reinforced to secure any required amount of longitudinal or tensile strength. By filling the void behind the lining, left after the shield moves forward, with gravel under high pressure prevents displacement of the soil, distributes the exterior pressure, and permanently centers the lining. Their use has effected an economy of from 30 to 60 per cent over the estimates of cost of the same work constructed with cast iron lining.

Notwithstanding the very limited dimensions of the Linden Avenue tunnel, machinery has been designed and constructed that enables all of the operations to be carried on in exactly the same manner as for a tunnel several times as large, and thus afford a convincing demonstration of their efficiency.

Engineers and contractors who wish to visit this Linden avenue sewer work will be cordially welcomed by the contractor.

A Costly Protest Against Inefficient Highway Supervision

The State of Illinois, now thoroughly embarked on a highway construction and maintenance program for which there is available in 1921 alone the sum of $20,000,000, faces the strong probability, amounting almost to certainty, of loss of an important per-

centage of that sum through the narrow-gauge, niggardly and inexcusable policy that has resulted in the resignation of its state highway engineer, A. R. Hirst, who during the fourteen years of his connection with this work has had responsible charge of the execution of $40,000,000 worth of road and bridge work.

Mr. Hirst has become thoroughly identified with and strongly attached to the great engineering features of his department and regretfully abandoned work which should be a monument to his state and to his personal reputation and satisfying the creative instinct that is the most important feature of a true engineer's qualifications. He felt compelled to resign, however, because the conditions are such that he finds it impossible to secure the proper execution of the work in accordance with the best interests of the public and first class engineering operations.

His own salary of $7,500 (very moderate for the ability and services rendered), although larger than that of most of the officials in that state, has not of itself been tempting, yet his love of the work and his ambitions for the public good made him wish to continue in his position for the rest of his active life.

In a manly and illuminating letter of resignation he says that he "can no longer be responsible for the proper expenditure of the tremendous sums now available when public sentiment will not support the legislature, the highway commissioner and the county board in the payment of salaries adequate to maintain a favorable and efficient organization that can save or waste hundreds of dollars every step and millions in their construction and administrative policies."

The salary paid the county commissioners is insufficient, the clerical organizations are inadequate, and as fast as the engineering department trains men they are hired away by commercial organizations. In 1920 the State Highway Commission lost 27 per cent of its principal employees.

In spite of the handicap of underpaid staff and a huge turnover in its personnel, the highway department has probably gotten 75 per cent of the results that might have been attained with adequate public support, but a new era of enormous expenditures is now being entered and the competitions for brains and experience of superior value in planning and building highways and for talent in all the fields allied to highway construction is keen and intense, and unless the public "equips itself with eminently fitted representatives the losses in poor roads and unjustified prices will be appalling."

As Mr. Hirst's utmost efforts have, through lack of public support, failed to remedy the evil, he feels that his only alternative in justice to himself and the public is the resignation which is sure to be a deplorable and extremely costly protest for the State. This, or greater, is the price that the public must pay when it cannot or will not recognize or remunerate honesty, ability and efficiency.

The city of Winona, Miss., has issued $60,000 worth of bonds for the purchase of the plant of the Winona Light, Ice, Water and Sewerage Company. The plant will be entirely remodeled and will be put on a paying basis, known as the Winona Public Utility Plant. Water and light service will be extended to cover the whole town, instead of covering not over 50 per cent, as at present. Both water and electric service will be put on 100 per cent metered basis.

Jno. T. Sharp, Jr., who is at present superintendent of the Canton Electric Light and Water Works, has been made manager of the Winona Public Utility Plant and will have charge of both plants and will do the purchasing and engineering. H. E. Johnson, recently of Dyersburg, Tenn., is local superintendent at Winona.

Educating Water Works Consumers

Obtaining confidence and co-operation of consumers in changing from flat rate to meters, by first educating employees.

The business policies and methods of the Spring Valley Water Co. of San Francisco were described at some length by the water sales manager of the company, O. E. Clemens, in a paper before the California section of the American Water Works Association at a recent meeting.

One of the most interesting features was the method employed by the company in securing public confidence and co-operation in changing from flat rate to meter rate.

The company began installing meters on residential services during the summer of 1916 for test purposes, as meter rates could not be applied to that class of consumers under the ordinance then existing. The idea met with a wave of opposition, but in October 1918 the state railroad commission authorized the use of meters and the application of a modern system of rates based on metering. Anticipating the consent of the railroad commission, the company had continued installing meters and by October 1918 had 50,000 set, in addition to the 20,000 which already existed on the commercial services. There are now about 75,000 meters in the city, of which 3,500 are installed in basement areas under the sidewalks in the downtown section and the remaining 71,500 are in the sidewalks along the curb line. About 20,000 accounts are commercial, consisting of factories, refineries, shops, railways, stores, hotels, and apartment houses, and over 50,000 are residential accounts. Altogether there are about 72,000 active consumers. (Apparently a number of the consumers are supplied through more than one meter.)

In spite of the original opposition, "after two years of intensive educational and service work, the public is now thoroughly converted to meters and we can state with the utmost confidence that if the question should be put to a vote, those in

favor of returning to the former system of billing for water service would be hopelessly in the minority." This result was secured by educating both the public and the company's employees and by serving the public to the best of the company's ability.

In educating employees, classes were held at the shop, where they were shown the workings of the water meter and what a wonderfully accurate instrument it is, how seldom it can get out of order and how, if it does go wrong, it is almost always in favor of the consumer. "The time spent on this was well worth while, for the men gained full confidence in the instrument and could meet any and all comers on the subject. And many men were found in this city, otherwise very intelligent and well read, who possessed a blind and unreasoning prejudice against meters and honestly believed that they could not be depended upon for accurate registration.

"The next step was to drill the company's personnel in the logic of the new rate schedule. This schedule is one that at first aroused much adverse comment owing to the elimination of the familiar minimum bill and the substitution of the monthly service charge, an item independent of the charge for water delivered." Mr. Clemens described at some length this system of rates, which has been adopted by a number of cities in the east and described several times in this journal. The monthly service charge was designed to cover the cost of "maintenance and repairs to mains and services, inspection of plumbing and fixtures for the consumers, reading meters, bookkeeping, billing and collecting." As adopted by this company, it also includes the estimated cost of water passing through the meter without being registered. Mr. Clemens stating that tests had shown that the average ⅝-inch household meter passed an average of about 50 gallons a day without registering, and larger meters proportionately larger amounts. The service charge was fixed at 65 cents a month for ⅝-inch meters, increasing for the various sizes up to $40 a month for a large 8-inch connection.

In commenting upon the service charge system, the Railroad Commission said: "The minimum charge is invariably higher than the service charge, and it involves the payment by each consumer for a fixed amount of water regardless of whether or not he uses it. There is no answer known to us which can be made to the man who complains that under a minimum rate he is compelled to pay the same amount for 100 cubic feet of water as his neighbor pays for 300 to 400 cubic feet, depending upon the amount fixed for minimum use.

"We believe that under the conditions of service we are dealing with herein, the service charge once established and thoroughly understood will be agreed to as the fairest and most equitable method of fixing rates."

In educating the public, the company wanted quick results and used paid advertisements in the big dailies and also in the district newspapers. An expert in advertising was placed in charge of this, and explained in simple and effective language the whys of metering and the new meter schedule. Adverse arguments made by consumers were quoted and answered. The causes of large water bills were enumerated and specific cases of cause and cure were cited. The square deal was constantly preached and was lived up to by the company's operating forces. The public was invited to come to the company with its water troubles and to call on its service department for assistance.

The advertising was backed up by real service and all complaints, no matter how trivial, were thoroughly investigated and helpful letters sent to the complainant. Defective fixtures were located and specific recommendations regarding repairs were made. Unnecessary and wasteful uses were pointed out and constructive criticism offered. As a result, instead of an office full of irate consumers and a host of insulting letters in every mail, the company receives only relatively few complaints at the information and adjustment window; asking, not demanding, an investigation of abnormal bills and leaving entirely to the company the question of the adjustment of the cost of water lost through the leaking fixtures. Hardly a mail delivered but brings one or more letters of appreciation from pleased consumers.

"The results accomplished and the good feeling developed have repaid a hundred fold the money and energy expended on this educational and constructive campaign. Aside from the tremendous saving of four billion gallons of water a year, previously wasted and benefiting none, it is possible to point to concrete saving in operating expense, largely attributable to the changed attitude of the public and its wholesome effect on the morale of the company's employees."

Comparing October 1920 with October 1915, the number of active consumers increased from 66,000 to 72,000 but the average delivery of water decreased from 45 million to 36½ million, while the gross revenue increased from $298,000 to $331,000. The number of employees decreased from 119 to 113, the number of plumbing and rating inspectors having decreased from 19 to 8, the field collectors from 24 to 21, builders and contractors supply from 7 to 1, shut-off men from 7 to 4; while the meter readers increased from 9 on ⅔ time to 13 on full time, and the bookkeepers and billers from 14 to 28. The smaller force handles a larger business and gives the public more satisfactory personal contact. The reduction in the force is due partly to the reorganization and realignment of the department, parly to the 100 per cent metered condition of the business, partly to improvement of some methods, the elimination of others and the introduction of new ones. In addition, credit must be given to the changed attitude of the public, which has been meeting the company in a co-operative way which greatly improved the morale of the employees and indirectly increased their efficiency.

Although 36,500,000 gallons per day are delivered to the city reservoirs, only 29,800,000 are measured by the meters, 18,000,000 of this going

to commercial consumers, 10,000,000 to residential, 1,000,000 for municipal uses, 750,000 to ships and 50,000 to contractors and construction work. The unmeasured 6,700,000 gallons covers fire uses, reservoir evaporation, leaking in mains and services, flushing of mains and sewers, and presumably meter slippage.

All meters are read once a month, the entire city being covered by 13 readers in 21 working days. The average number of meters in basements read per day, is 100 to 150, while of the other meters 250 to 300 per day are read in the semi-commercial district where readers are delayed by traffic, merchandise on the sidewalks, etc.; and in the open section solidly built they average better than 500, some runs reaching 700 in 7 hours reading time. The five remaining days of the month are occupied in taking readings previously unobtainable, cleaning dials, and working up reports on broken boxes.

Use of Copper Sulphate in Kansas City Reservoir *

By GEORGE F. GILKISON †

Application of copper solution directly onto walls successful after other methods had failed.

The object of this paper is not to introduce a new method for the control of algae, but rather to show how the Kansas City, Mo., Water Department has, by changing the application of copper sulphate from the water to the basin walls, been able to control this annoying growth in their clear water basins.

Kansas City takes its water supply from the Missouri river at the Quindaro pumping station, 10 miles above the city. This station has a basin capacity of 90,000,000 gallons. The water is purified by sedimentation aided by coagulation and chlorination. It is then delivered to the Turkey Creek station, which is the distributing station. There are seven storage basins with a total capacity of 38,000,000 gallons located at different points throughout the city. It is in these basins that the algae growth causes the most annoyance. The basin becomes very unsightly, due to the fact that Spirogyra predominates and appears in long filaments throughout the basin. It also causes trouble in the meters by stopping up the strainers. At times offensive odors are generated, due to the development of Anabaena and other blue-green algae.

The method first used to control this growth was to scrub the walls with long-handled wire brushes. This was not successful. The algae was torn loose from the walls and a large amount of it floated in the water and would attach itself to the wall again at the first opportunity.

The next method tried was taking a known amount of copper sulphate in a sack and by means of a rope attached to it, dragging the sack along the wall on which the algae was growing. The disadvantages of this method were that the current caused by the sack would carry the copper sulphate solution away from the wall and the strength of the solution being applied was unknown. This method also required a great deal of time, as the sack had to be drawn back and forth over the same wall to kill the algae growth.

To overcome the uncertainty of concentration, an experiment was made at the Quindaro station in which the copper sulphate was applied with the coagulant to the water. Copper sulphate being incompatible with aluminum sulphate, the two were dissolved in the same solution and applied to the water as it passed over the weir by means of a perforated pipe line. The volume of water passing over the weir was known. Copper sulphate was added at this point, and in this way it was possible to calculate the parts per million in the basin. A start was made with 0.25 part per million and this was progressively increased to 1.5 parts per million. There was no apparent action on the wall growth until the concentration of the copper sulphate reached 1 part per million, and at that concentration the algae at the end of the basin at which the copper sulphate was being applied was killed, but 1.5 parts per million were necessary to clear the far wall. This experiment was followed by an enormous increase in the bacterial count in the basin. The alkalinity of the water at the time of this experiment was 185 parts per million. While chemical analyses were not made on the effluent water from this basin, it is safe to say that most of the copper sulphate was lost by reaction with the alkalinity of the water. The following varieties of fish were present in the basin: catfish, carp, perch, drum, shad and buffalo, none of which was killed.

Copper sulphate is now used in a known strength solution, and is applied directly to the algae growth on the basin walls. The water elevation in the basin to be treated is brought down below the algae line, which is about 6 feet below the normal elevation in the basins. This leaves the algae clinging to the wall. A paint spraying pump is attached to an 8-gallon keg which is mounted on wheels and equipped with a handle. A 5 per cent aquaeous solution of copper sulphate is made by dissolving 6½ pounds of copper sulphate crystals in 10 gallons of water and poured into the keg. While one man operates the pump another man directs the flow of the solution, which is delivered in a fine spray. After an hour the walls are scrubbed with a wire brush and the basin is again filled to normal elevation.

One gallon of this solution will cover 125 square feet of wall surface and can be applied by two men with a spraying machine in four minutes. By carrying out this method every two months during the warm weather, it is possible to keep the basin walls comparatively free from algae.

*Paper before the Iowa Section of the American Water Work Association, November 6, 1920.

†Chief Chemist, Water Department, Kansas City, Mo.

Delaware Highway Designs and Specifications

Some of the more important features of the specifications with reference to freight rate compensation, excavation, mixing, finishing and protecting concrete, bridge construction, etc.

As stated in a previous article dealing with the Delaware State Highway Department, concrete pavements were adopted as the general standard for that state, with brick pavement on a concrete base and penetration macadam for special cases. These conform to seven typical cross sections, with different dimensions as shown in the accompanying diagram. Their construction is governed by specifications that conform to advanced practice, with some special features designed to provide for local conditions.

Some of the features of the specifications that have received special study or are thought to be particularly important are here presented. They are well calculated to promote the excellence of the work and to secure hearty co-operation of the contractor by assuring him of fair treatment and consideration.

FREIGHT COMPENSATION

In case freight rates are increased after the receipt of bids and before the date set in the proposal for the completion of the contract, the contractor will be paid extra an amount equal to the increase in freight rates paid by him on the materials used in this contract, the receipted freight bills having previously been filed with the department.

Likewise deductions will be made in a similar manner should a reduction in freight rates be secured.

EXCAVATION

Excavation includes the grading and rolling and otherwise compacting of the surface of the roadway and shoulders and the cleaning and sloping to grades of side ditches. A sub-grade must be shaped and compacted to conform to line and grade and brought to an even surface by rolling the entire area with a three-wheel power roller weighing at least 10 tons and by tamping any portion inaccessible to the roller. The sub-grades must be maintained undisturbed at least 200 feet in advance of the placing of the roadway materials. If an existing macadam road surface corresponds approximately to the grade of the proposed roadway it shall be scarified to a depth of at least 4 inches for the full width of the new pavement and shaped to conform to the new cross section.

An important requirement intended to prevent the formation of longitudinal cracks provides that, if the roadway of the present road follows the traveled way of an old road, then the surface of the old road, which is beneath the new pavement, shall be thoroughly plowed and scarified to a depth of 10 inches below the original surface, after which it shall be reshaped and rolled as hereinbefore specified to secure a sub-grade of uniform rigidity.

CONCRETE PAVEMENT

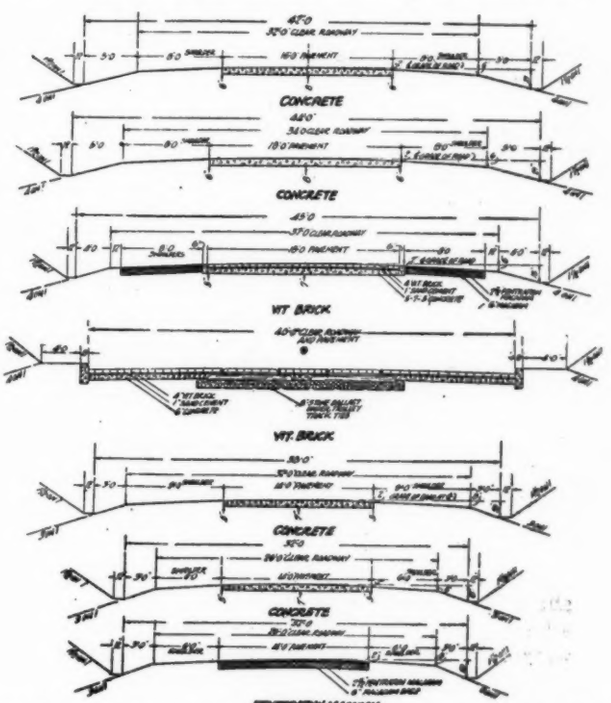
Immediately before laying the concrete, the sub-grade shall be checked with an approved template and shall be brought to true grade. If this requires the addition of loose earth it must be thoroughly tamped by hand. Rakes must not be used for spreading concrete. The forms must be maintained in position true to line and grade at all times for at least 200 feet in advance of the concrete mixer and retained in position for at least 12 hours after the concrete has been placed.

Mixing Concrete.—Boxes with bottoms or approved wheelbarrows shall be furnished and used for measuring the aggregate, built to such dimensions as, when struck, will give the required volume. Every box or barrow shall be struck off before emptying.

The mixer shall be equipped with an automatic locking device, which will prevent the mixer being discharged until the batch has been mixed the required time.

The mixer shall also be equipped with an automatic water measuring device and a visible water gauge.

Concrete shall be mixed in the proportions of:



TYPICAL SECTION OF DELAWARE STATE AND STATE AID ROADS

1 standard bag portland cement, 0.1 cubic ft. hydrated lime, 2 cubic ft. of fine aggregate, and 4 cubic ft. of coarse aggregate. Except that, to secure the densest mixture, the engineer may vary the coarse aggregate up to 5.

The materials shall be mixed in a batch mixer of approved type for 1½ minutes after all the materials are in the drum, at a speed of not less than 14 nor more than 20 revolutions per minute. Any batch mixed less than 1½ minutes shall not be allowed in the roadway, and shall be disposed of as directed. No material shall be placed in the drum until all the previous batch has been discharged. Water shall be added at the time the materials are being run into the mixer. Only sufficient water shall be used to produce a plastic, workable concrete, of which each and every batch must be of uniform consistency, as determined by the engineer. Concrete that will flow on the sub-grade, or in which there shows any tendency towards segregation of the aggregate, will not be permitted.

Finishing Concrete.—On all contracts of 3 miles or over in length, the surface of the concrete shall be struck off, tamped and belted with an approved finishing machine in such a manner as shall be acceptable to the engineer. On contracts less than 3 miles in length, the surface of the pavement may be finished by hand in the following manner: The surface of the concrete shall be leveled and immediately struck off by means of a steel screed or template weighing not less than 25 pounds per lineal foot and having a face resting on the forms of not less than 8 inches in width. The template shall be moved with a combined longitudinal and crosswise motion. If necessary, the template shall be used a second time or until a true surface is obtained. While the concrete is being struck off, at least 3 men shall be at work, leveling, spading and tamping the concrete in front of the template.

After the concrete has been struck off, it shall be rolled with a roller approximately 6 feet in length, 12 inches in diameter, and weighing from 12 to 15 pounds per lineal foot. The roller shall be moved slowly at a uniform speed from one side of the pavement to the other, diagonally so as to advance it longitudinally not more than 2 feet in passing from one side of the pavement to the other. The rolling shall be continued at intervals until free water ceases to come to the surface, and this operation shall be repeated at least three times.

After the rolling has been completed the concrete shall be finished by a bow belt not less than 10 inches in width. The belt shall be of 4-ply canvas-rubber composition, about 1 foot longer than the width of the pavement and stretched tight by means of a wooden bow. The belt shall be moved with a see-saw motion across the pavement using long, vigorous strokes, with a slight longitudinal advance, which may be increased in later beltings. Just before the initial set takes places the concrete shall be given a final belting in order to produce a uniform surface of gritty texture. This belting shall be of short, rapid, transverse strokes having a sweeping longitudinal motion. Badly worn belts shall be rejected and new ones supplied. The outer edge of the concrete pavement shall be finished with an edging tool ¼ inch radius. Joints shall be installed at the end of each day's work or whenever the mixer is stopped for more than 30 minutes or when directed. At each joint shall be placed five ⅝ inch round, smooth steel bars 4 feet long, dipped in tar or asphalt to insure freedom of movement within the concrete.

Protecting Fresh Concrete—Freshly laid concrete shall be protected from the sun and wind by canvas covering placed so as not to come in contact with the concrete surface. In case of rain, the covers shall be removed until the rain is over. After the concrete has hardened sufficiently, the surface of the pavement shall be covered with not less than 2 inches of earth, which shall be kept soaked with water for at least 14 days. The earth covering shall not be removed for at least 30 days, and in cool weather for an additional time if required by the engineer. The method known as ponding may be used if desired, the surface of the concrete being kept covered by water for 14 days. For each 1000 feet of concrete pavement which has been laid less than 14 days, there shall be at least one man who shall devote his entire time to watering.

A 10-foot straightedge shall be placed parallel to the center line of the highway, so as to bridge any depressions, and ordinates measured from the face of the straightedge to the surface of the concrete shall not exceed 1-16 inch for each foot in distance from either point of contact. When variations are found in excess of this amount the contractor shall either remove the entire slab or correct the unevenness in a manner acceptable to the engineer, but no depressions shall be filled with concrete unless the slab has been cut so as to secure a thickness of 4 inches of new material with vertical sides.

BRIDGES

Few streams are crossed by the state highways and the maximum span does not exceed 50 feet, therefore bridge construction does not involve great engineering difficulties or elaborate equipment. Separate designs adapted to the conditions and requirements are made for each span. All of them are made heavy for all possible future traffic, with dimensions to give ample clearance for waterways and vehicles, are neatly finished and present an attractive appearance suited to the surroundings.

Concrete in the arch ring, spandrel walls and foundations is designated on the plans to be one of three grades, respectively proportioned 1 cement, 2 fine aggregate and 4 coarse aggregate; or 1 cement, 2½ fine aggregate and 5 coarse aggregate; or 1 cement, 3 fine aggregate and 6 coarse aggregate.

No concrete shall be deposited in water. If it is found impossible to keep the foundation dry on account of springs in the bottom, a layer of concrete not more than 6 inches deep shall be spread over the bottom to seal it, and after it has set, the water shall be pumped out and the remainder of the foundation placed in the dry.

The surface finish of all exposed concrete shall be spaded, rubbed or tooled. The arch ring shall not be concreted until the fill around the abutments has been carried up to the skewback. Arch rings shall preferably be cast in a single continuous operation; but where this is impracticable they may be divided, by vertical bulkheads, into longitudinal sections, or by radial bulkheads into trans-

verse sections, of such size that each section can be cast in a continuous operation.

Transverse sections shall be so arranged that initial stress will not be created in the reinforcement. In either method, work shall be carried on symmetrically about the crown of the arch and the sections shall be keyed or doweled together as the engineer directs. The spandrel walls shall not be cast until after the centers have been struck if so directed by the engineer or called for on the plans, and no part of the coping or railing shall be cast until the spandrel wall has been completed. In favorable weather, centers shall remain in place under arches of less than 60 foot span for at least 21 days. In unfavorable weather centers shall remain in place under all arches as long as the engineer may deem necessary.

UNDERGROUND WORK

In order to deal justly with the contractor when unforeseen conditions are developed in the construction of foundations, it is provided that if it becomes necessary to carry the foundations for any structure below the depths shown on plans, additional payment will be made by increasing the unit price of the additional concrete so required on the following basis:

For the first foot below the grade shown on plans, the unit contract price for concrete masonry of the class called for, plus 10 per cent;

For the second foot, the unit contract price plus 15 per cent; and increasing for each additional foot 5 per cent of the unit contract price.

Toledo Garbage Disposal

Toledo, Ohio, has recently let a contract for disposing of its garbage by the reduction method, the contract having been awarded to the Toledo Disposal Company. Under this contract the city pays $1.25 a ton.

Bids were first received by Service Director Goodwillie in April, 1920, when, as described in our issue of May 8, four of the bidders offered to pay the city for the garbage and the fifth, the Toledo Disposal Co., asked to be paid $.89 a ton under a ten-year contract. Of the first four, two proposed to feed the garbage to hogs, one offering the city $1.25 a ton under a ten-year contract and the other $1.26 a ton under a five-year contract. A third, the Michigan & Ohio Nu-Fuel Co., offered to pay $.75 a ton upon the basis of fuel manufactured from the garbage under a twenty-year contract. The fourth, the Pan-American Feed Milling Co., which proposed to convert the garbage into food for livestock, offered to pay $1 a ton.

The reduction method had already been used in Toledo for many years by the Toledo Disposal Co., which was paid $5,875 per year, the garbage being delivered by the city at the plant. The hog-feeding method had not been tried in Toledo and involved the finding of a suitable location for a hog farm in a neighborhood where it would not be a nuisance, and this involved considerable length of haul with the increased cost involved. The other two were new ideas which had not yet been tried out extensively.

For these and other reasons the service director decided not to award the contract on bids which were apparently most favorable, but to redraft the specifications and readvertise. In the new specifications, among other things, the definition of garbage was made clear and explicit and it was provided that no method would be considered that had not been in successful operation for at least two years. Also rigid requirements were set forth designed to insure sanitary handling of the garbage. The plant was required to include the office building and scale house with a wagon scale having a capacity of 20 tons, space and equipment for washing and cleaning the garbage wagons, with a sufficient water supply, a telephone at the plant, etc.

The specifications stated that "Consideration will be given by the city in the awarding of this contract not alone to the reliability of each bidder and his proposed process, together with the price offered as compensation to or from the city of Toledo for the garbage disposal, but also to the proposed location of the plant and the expense to the city to transport and haul the garbage to the plant or plants proposed to be constructed by said contractor."

Only three bids on the above specifications were received, two for hog feeding and one for reduction, the last of which was accepted. One of the former offered to pay the city $1.26 per ton, while the second offered two proposals, under one of which the city would pay $1 per ton, while the other offered to pay the city 5 cents per ton for delivery of the garbage at the city limits and 10 cents a ton additional for each mile of haul beyond the city to the hog farm.

The two hog-feeding proposals would have required a haul of seven or eight miles in one case and thirty miles in the other, the cost of which would soon have eaten up the difference in cost of disposal. Collection and delivery cost the city $76,000 in 1919, while disposal cost but $5,875. The service director estimated the cost of collection at $2.86 a ton as against $.29 a ton for disposal.

The amount to be paid the company under the new contract is considerably more than that paid under the present one for the past ten years, but the company claims that the increase is made necessary by the great increase in cost of coal and labor and the fact that the new contract requires more sanitary handling of the garbage.

Reinforced Concrete for Massachusetts Roads

The Highways Division of the Massachusetts Department of Public Works is expecting to build this year concrete roads with reinforcement, which has not heretofore been used in Massachusetts, although it has been in Pennsylvania, Illinois and other states. Probably the first of these reinforced concrete roads to be built will be on the Worcester-Springfield route, where the state expects to build something more than three miles of road 20 feet wide with a 3-foot shoulder on each side, both road and shoulder to rest upon a broken stone foundation. The road will be 6 inches thick at the sides and 7½

at the center, the under side being level, thus furnishing a crown of 1½ inches. At curves the concrete will be widened to 23 feet and banked for the greatest speed permissible, but so far as possible the curves will be made flat so that little banking will be required. The reinforcement will consist of ½-inch rods, which will extend through the expansion joints so that they will act as dowels. A longitudinal expansion joint will run continuously through the middle of the road and transverse joints will be placed at intervals of about 100 feet.

Filtration Plant Recommended for Buffalo

A water filtration plant to cost about $4,000,000 has been recommended by Arthur W. Kreinheder, commissioner of public works of Buffalo, in a communication sent the council on March 16. He asks that the council authorize the Bureau of Water to have plans and specifications prepared so that bids for a filtration plant may be obtained not later than February 1, 1922. He would have a sufficient amount of land already owned by the city set aside for this purpose, with area sufficient for a plant with a capacity to serve one million people. He recommends that the architectural plans for the buildings enclosing the plant conform to the architecture of the pumping station, and that the surrounding grounds be co-ordinated with the lands of the park department in that section.

The recommendation is based on a report recently completed by water commissioner George C. Andrews and George W. Fuller, of New York, as consulting engineer. Messrs. Andrews and Fuller, who have been studying the subject for over a year, report that the water supply of Buffalo is objectionably turbid for at least three months of the year when storms stir up the comparatively shallow end of Lake Erie in the vicinity of the intake. The only practicable remedy for this is filtration. A rapid sand filter with a rated capacity of 160,000,000 gallons per day plus a 15 per cent overload is recommended, believed to be ample for the city's needs until 1935. The cost, $4,000,000, is based upon present prices. The operating expenses are estimated at $125,000 a year. Buffalo has recently increased its water rates and it is estimated that the increased revenue combined with a reduction of water waste and control of consumption will be sufficient by 1925 to pay the interest and sinking fund charges on this investment as well as for the maintenance of the plant. One year is allowed for preparation of the plans for the plant and two or three years for its construction.

Although since the chlorination process was installed in 1914, the typhoid fever death rate in Buffalo has decreased approximately 50 per cent, the rate is twice as high as in Boston, New York, Cincinnati, Chicago and many other large cities.

Commissioner Kreinheder believes that "in times of industrial depression municipalities should prosecute public improvements. From present indications I am satisfied that during 1922 and 1923 construction costs will be lower and that it will be possible to build the plant at a reasonable expense."

San Francisco Votes Against Purchasing Water Works

On March 8, San Francisco voters defeated a proposal submitted to them for purchasing the property of the Spring Valley Water Company. Although the vote was 42,898 in favor and 31,082 against, a two-thirds vote was necessary to adopt the measure, which called for issuing bonds. There was very little organized opposition to the measure and on the other hand nearly all the civic, social and labor organizations of the city officials endorsed it. It appears that the opposition was based largely on the assumption that the $38,000,000 demanded by the company for its properties exceeded their value, although the railroad commission had fixed it at that amount.

This is the third time that this question has been before the voters, the first having been in 1910 and the second in 1915. In 1910 the property was offered for $35,000,000 and in 1915 for $34,000,000, but with certain properties not included which had been included in the first offer, thus making it really less reasonable.

Only a few years ago the people voted overwhelmingly in favor of obtaining a municipal water supply by building a large reservoir in the Hetch-Hetchy valley, authorizing $45,000,000 for that purpose. The owners of irrigable lands in that valley succeeded in having imposed on the city a number of conditions, one of these being that it would make use of all near-by sources before interfering with the rights of irrigation claimants. City officials have stated that there is now no possibility of obtaining water for the city from Hetch-Hetchy during the present generation, and the cost of bringing it from that source is so great that, if added to the amount that would have to be paid to secure the near-by Spring Valley supply, would bring San Francisco's bonded indebtedness nearly to the charter debt limit. In fact, the idea of obtaining a water supply from that source has now been practically abandoned and it is considered only as a power proposition.

Passaic Valley Sewer Injunction

In an article under this head which appeared in the issue of March 5, appeared a statement which is contradicted by the writer of the following letter, who was designing engineer for the commission referred to. As stated in the article, the paragraph referred to was abstracted from a report of the injunction suit and presumably the counsel in the case was responsible for the erroneous statement. The object of the statement apparently was to prove that New York City was preparing to take very pronounced and expensive steps toward preventing pollution of the harbor.

Editor, PUBLIC WORKS:
New York City.

SIR: May I correct an error in the statement on Page 208 of PUBLIC WORKS for March 5 that "an artificial island was proposed (by the Metropolitan Sewerage Commission) for another plant at a cost of more than $41,000,000."

This referred to the project for collecting 200 million gallons of sewage daily from the territory draining to the Lower East River below Newtown Creek on the East Side and 26th street on the west to a pumping station at South 5th street, Brooklyn, and pumping through a 12-foot 8-inch tunnel to an artificial island some 3 miles south of Coney Island, where it would be settled and discharged by submerged outlets.* Reference to Page 124 of the Commission's final report (1914) shows that this was estimated at $17,395,000 instead of $41,000,000, as in the article referred to.

As there has been much misapprehension as to the entire proposition, both scope and cost, it may be of interest to state that the volume of 200 million gallons daily by no means represents all of the sewage tributary to the Lower East River, the balance of which would have been treated locally in either this or the Red Hook Project and to give further details as to the cost as estimated early in 1914.

Estimated cost of ocean island project made in 1914 and based on a mean flow in 1960 of 200 million gallons daily:

CONSTRUCTION

Interceptors, including storm overflows, grit chambers and screens	$ 2,186,800
East river siphon	282,100
Pumping stations	1,971,000
Force main and outfall sewer	8,627,000
Outland island	615,500
Treatment plant	1,125,000
Outlet well and submerged outlets	178,000
Sludge steamer	140,000
Engineering and contingencies	2,268,600
Total	$17,394,000

ANNUAL CHARGES

Maintenance of interceptors and outfall sewer	$ 11,300
Pumping	258,000
Grit removal, sewage treatment and sludge disposal	162,100
Fixed charges	880,100
Total	$1,311,500

With the exception of one or two of the smaller items I have never seen any occasion to revise these figures for the date when they were made although they would naturally be very much greater to-day. The moderate cost of constructing an island in the Lower Bay is explained by the shallow water at this location and the favorable conditions for construction.

Very truly yours,
KENNETH ALLEN,
Sanitary Engineer, Board of Estimate and Apportionment, City of New York.

*Described in *Municipal Journal* for November 4, 1915

Finances of Cities

The report of the Census Bureau on the financial statistics of cities of 30,000 population and over for 1919 will soon be issued and a synopsis of the figures has been given out by the bureau. The statistics have been compiled under the direction of Starke M. Grogan, chief statistician for state and city statistics and includes 227 cities.

These cities made total expenditures exceeding their revenues by nearly $9,000,000, or about 26 cents per capita; but the revenues exceeded payment for current expenses and interest by more than 25 times that amount. That is, if we omit expenditures made for permanent improvements, the cities lived well within their incomes and almost paid for all of their permanent improvements as well. There were only four cities in which the revenue receipts did not exceed the current departmental expenses and interest, and in 52 per cent of the whole number, including some of the larger cities, the revenues exceed all expenditures for governmental costs, including permanent improvements. In 1918 this last statement could be made of only 35 per cent of the cities.

Averaging all of the 227 cities, the expenditures for governmental costs was $35.58 per capita. Of this total, $21.75 was for expenses of general departments—legislative, executive and judicial establishments, schools, police and fire departments, sanitation, etc.; $7.38 per capita was for outlays (permanent investments); $4.52 was for interest on indebtedness, and $1.92 was for expenses of public service enterprises such as water supply systems, docks, wharves, etc.

Next to taxes, the largest revenue was derived from public service enterprises, the earnings of these having totaled $127,399,258. This sum exceeds the payments for such enterprises by $60,699,192, or $1.76 per capita. Nearly 80 per cent of this revenue, or $95,000,000, came from water supply systems.

The net indebtedness, being the funded and floating debt less the assets in general sinking funds, totaled $2,697,551,844, or $77.82 per capita.

Surfacing on Lincoln Highway

The Lincoln Highway as now laid out contains 3,305 miles from Broadway and 42d street, New York, to the Golden Gate, San Francisco, which is about 84 miles less than the route as it was laid out seven years ago. The Lincoln Highway Association reports that 2,853 miles of this distance has been improved, 542 miles of this having been done in 1920. This improvement, however, includes a considerable amount of grading only; in fact, about 1,880 miles, or nearly 60 per cent, consists of graded gravel, natural gravel, graded earth, natural earth, and sand.

Of the surfaced road, 422 miles is of concrete, 402 miles of bituminous macadam, 287 miles of macadam, 220 miles of brick, 78 of earth, 6 of creosoted block and 7 of granite block.

It is reported that a total of $31,284,520 has been spent upon the Lincoln Highway thus far, and it is hoped to add $10,000,000 worth of construction work to the highway during 1921. During 1920, 127 miles of concrete road was built, 12 miles of bituminous macadam, 7 miles of brick, half a mile of macadam, 188 miles of gravel and 207 miles of permanent earth grade.

Bayonne Desires New Water Supply

Among the several New Jersey cities that are endeavoring to secure the few remaining sources of water supply in northern New Jersey is Bayonne, which is seeking to obtain the right to construct a dam across the Ramapo river at Oakland and create a reservoir with a capacity of 15,000,000,000 gallons, with the right to divert 50,000,000 gallons a day for its own use and that of adjacent municipalities with which it may make contracts. This plan is being opposed by wealthy residents of the valley, who claim that $10,000,000 worth of property would be destroyed by the creation of the reservoir. The matter is still before the State Board of Conservation and a decision is expected within the next few months.

Pavements Laid During 1920

Quantities are square yards or miles otherwise indicated.

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
South Carolina:									
Charleston	7,633								
Chester					5,900				
Manning	40,000								
Spartanburg		65,000							
South Dakota:									
Madison					24,653				
Tennessee:									
Nashville					33,363				
Texas:									
Bonham									20,000
El Paso					115,053				
Ft. Worth					87,147				
Houston					61,353				
San Antonio					51,543				
Utah:									
American Fork					33,935				
Brigham City					26,546				
Lehi					27,138				
Virginia:									
Roanoke	1.86							1.6	
Richmond					6,077				
Washington:									
Camas					2,500				
Dayton					30,000				
Grandview					25,890				
N. Vancouver					4,563				
Puyallup					19,073				
Tappenish					53,260				
Vancouver					41,379				
Yakima					1,327				
Wisconsin:									
Ashland						30,050			
Janesville	63,425								
Port Angeles		7,373			12,377				
Canada:									
Brampton, Ont.									
Brockville, Ont.					29,399				
Chilliwack, B. C.					19,468				
Moncton, N. B.					31,553				
Owen Sound, Ont.					24,619				
Pickering, Ont.					3,176				
Sarnia, Ont.					5,525				
St. Boniface, Man.					9,009				
Toronto, Ont.	11.81				7.95				
Vancouver, B. C.					39,470				
Walkerville, Ont.		.44			13,219				
Woodstock, Ont.					1,605				

Cities and States	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement Sidewalks
Alabama:									
Gadsden								3,000	
Arizona:									
Douglas						500			100,000§
Arkansas:									
Pine Bluff								19,000	1.50
California:									
El Centro									2,400b
Los Angeles						101,775		885,721	1,008,452§
Monrovia								3	½
Ontario						¼			
Pasadena						153,431			11,525§
San Luis Obispo					18,000			32,000	5,000
Colorado:									
Boulder								3	
Ft. Collins					5,000			4,118†	1,000§
Salida									100§§
Connecticut:									
Ansonia		1,000							2,000
Norwich					3,000		1,200		
Stamford									10,000§
Georgia:									
Augusta					½	3.7		3	2
Idaho:									
Coeur d'Alene							3		
Illinois:									
Cairo							4,700		
Chicago		.04	2.37	22		16.12			
Chicago Heights						3,600			11,760§
Decatur			6,090b	3,188b					3
Evanston						7,223			2,295b
Moline					1,040	1,566			58,000
Oak Park						45,962			
Olney									1,000§§
Quincy			32,000	28,300	2,620	1,717			
Savanna									4,400
Wheaton			22,000		2,210				
Indiana:									
Crawfordsville								823	3,697§
Evansville						3,135.84			
Kokomo						1,707			14,642§
New Albany						10,127	2,014		17,746
Wabash							7,000		½

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic*	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
Kansas:									
Arkansas City			79,000						
Columbus								½	
Kansas City			4,800			3,500			
Louisiana:									
Lafayette								2½	
Monroe									5
Maine:									
Portland		3,928							
Maryland:									
Frederick			500			3;200			
Massachusetts:									
Framingham						4,476		12,900	242
Holyoke		684				39,403			
Lawrence		6,900							
Lowell		5,839					14,737	24,237	
Malden		2,100				3,300			1,800
Medford		8,716							
Newton								52,606	52,000§
Provinctown							3		2
Webster									1.850b
Michigan:									
Bay City									8,000b
Holland									20,000§
Ishpeming								3,500	
Munising							500		1,000
River Rouge					17,185.48				
Saginaw								4,500	
Minnesota:									
Chisholm									2,000
St. Cloud									11,500
Missouri:									
Boonville						375§ §			
Jefferson City								10,000	8,000
Maplewood					14,000				2,000
Nevada								6½	
Poplar Bluff									4,000§ §
St. Louis		7.104	34,845	39.193		6,460			
University City						3,440			
Montana:									
Havre								1½	
New Jersey:									
Bridgeton					19,263			5	
Irvington					2.400	46,109			
Millville									
Paterson					4,700			½	
Roosevelt					10.000		71.021		
Roselle Park					14,360				20,000
New York:									
Albany		5,000	10,500		11,000	1,400			
Elmira			14,871						
Glens Falls					165				21,600§
Hornell							1	2	
Jamestown			13 000						
Lockport			24,800c		110,100c				
Plattsburgh									3,000
Port Chester		1,166							30,000§
Poughkeepsie						5,570			
Richmond		20,846	9,444	7.810		3,701	2 812		181,637
Schenectady					5,312.08				
Syracuse			1.63	0.25					
Utica					3,372	3,150			19,534
North Carolina:									
Asheville							4,000b		914
Marysville									
Niles			22,000						23 000§
Sidney									600§ §
Toledo			5,810	29,928	27,329				
Oklahoma:								8a	
Hobart						3,500b		2	1½
Lawton									
Oregon:									86,000§
Dallas		.0113				9,1431			509,475§
Portland									
Pennsylvania:			7,000						
Bradford			10,000						
Clearfield									935
Corry									32,000
Erie			2,000						
Greenville							27,000		3,500
Hanover	10.427						62,244.5		500
Hazelton					2.500				
Hollidaysburg									3,000§
Jersey Shore									
Media		5.341	.516	.831		05	4.30		
Philadelphia		119,600	35.100			1,240			88,500
Pittsburgh								5,300	3,000§
Summit Hill					3,000				
Warren			13,138						
Woodlawn									
Rhode Island:							2,330		
Newport		13.215					1,006		6,490
Pawtucket									
South Dakota:									2
Aberdeen						2.70			1½
Sioux Falls								2	1,400
Watertown									
Texas:									4,000§ §
Amarillo									
Bonham			20.000						¾
Childress			38,000			7,000			4
Cisco			35,700						
Eastland									

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bithulithic	Bitoslag	Rock Ashphalt	Willite	Asphalt Macadam	Tar Macadam
Galveston	.....	.....	6,000	.....	5,880	.....	.....	.....	.....
Vermont:									
Bennington	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ruthland	.....	.....	.....	.....	11,000	.....	1.1	.....	.....
Virginia:									
Roanoke	.....	.....	.....	.....	1.6	3,467	.....	.....	1,442
Washington:									
Auburn	.....	.....	.....	.....	.....	.....	1.1	.....	.....
West Virginia:									
Clarksburg	.....	.....	2	.....	.....	3	.....	.....	1¼
Moundsville	.....	.....	.....	.....	.....	3	.....	.....	.....
Wisconsin:									
Ashland	.....	.....	.....	.....	.....	.....	.....	.....	.....
Janesville	.....	.....	10,655	.....	.....	1¼	.....	.....	6
Lake Geneva	.....	.....	.....	.....	.....	.....	.....	.....	.....
Menosha	.....	.....	.....	.....	6,857	.....	.....	.....	400§
Neemah	.....	.....	.....	.....	6.000	.....	.....	.....	.....
Port Angeles	.....	.....	.....	.....	16.000	5,029	.....	14,070b	916b
West Allis	.....	.....	.....	.....	1.76	.....	.....	.....	.....
Canada:									
Toronto, Ont.	.....	.....	1.37	.....	.....	.....	.26	.....	6.12

¶—Information furnished by manuaftcurers. §—Vibrolithic. †—Cubic yards. §—Square feet. ‡—700 Topeka on stone base; 3000 on concrete base. J*—5 ft. wide. ††—5381 lineal feet, 30 ft. wide, asphalt filler; 3572 lineal feet, sand filler. § §—Feet. a—Blocks. b—Lineal feet. c—Dollars.

1920 PAVING NOT TABULATED

A few cities have laid pavement or sidewalk not covered by our classification. Among these, Chicopee, Mass., laid 4,664 squares of "national" pavement and relaid 225 yards of stone block pavement; Orange, Conn., laid 3,000 square yards of "national" pavement; Beaver Falls, Pa., did 9,600 square yards of resurfacing with asphaltic concrete on old brick pavement; Danville, Va., laid 8,743 square yards of asphalt surfacing over old cobblestones; Washington, D. C., resurfaced 35,375 square yards of sheet asphalt; Boston, Mass., resurfaced 180,000 square yards of asphalt macadam and 60,000 square yards of tar macadam; Longview, Texas, laid 3,000 square yards of shell surface with asphalt, resurfaced 7,000 square yards of macadam with asphalt and resurfaced 4,000 square yards of asphalt macadam; Fort Myers, Fla., laid 9,000 square of asphalt; Newark, N. J., laid 2,416 square yards of asphalt block; South Orange, N. J., laid 10,046 square yards of asphalt block; Mamaroneck, N. Y., laid 7,930 square yards of Hassam pavement; Watertown, Mass., laid 26,075 yards of gravel treated with oil; Bakersfield, Cal., graded and oiled 57,298 square yards; Portsmouth, N. H., laid four miles of cinder roads; Sharon, Pa., laid 10,000 square yards of slag roads; Port Arthur, Texas, laid 17 miles of shell road with one-inch gravel top; Braintree, Mass., laid one mile of tar sidewalk; Laconia, N. H., laid 1,717 square yards of tar concrete sidewalk; and Springfield, Vt., laid 1,053 square yards of tar-sand sidewalks.

North Carolina's Highway Commission

The new highway law of North Carolina provides for a state highway commission consisting of a chairman from the state at large known as the state highway commissioner, and nine commissioners, one from each construction district, all to be appointed by the governor and confirmed by the senate. (The previous law called for four commissioners.) The act continues Chairman Frank Page in office for his unexpired term, his successor to be appointed for six years. Three of the new commissioners will have 2-year terms beginning April 1, 1921, three will have 4-year terms and three 6-year. The chairman is to give his full time to the work and his pay will be fixed by the council of state. (It was formerly $5,500.) He had all the authority of the commission when it is not in session. The other members receive $15 a day and traveling expenses ($10 was paid formerly) when engaged in carrying out the duties of their office.

The commission is to employ a state highway engineer, whose salary is to be fixed by the commission with the governor's approval, to hold office at the pleasure of the commission but not to exceed 4 years without reappointment. A total of $50,000,000 is authorized for the work. A system of roads to be improved by the state is designated, but these may be changed by the commission on objection by local authorities or otherwise. The first work of the commission is to post at the court house door in each county a map showing the routes adopted, 60 days being allowed for filing objections.

The general purposes as set forth in the opening section of the act, are to take over, establish and maintain approximately 5,500 miles of "hard-surfaced or other dependable highways" running to all county seats and all principal state institutions, and linking up with the state highways of all adjacent states and with national highways, by the most practicable routes, with special view to the development of agricultural, commercial and natural resources.

The funds are to be apportioned among the nine construction districts as nearly as possible on a uniform basis, one-third in proportion to the area of the district, one-third in proportion to the population and one-third in proportion to the highway mileage of the district.

It is declared to be the intention to establish a state system of highways, hard-surfacing them as rapidly as possible and maintaining the entire system in the most approved manner, work on the various lines to be of such character as will lead to ultimate hard-surfaced construction as rapidly as money, labor and materials will permit, and to a state system of durable, hard-surfaced, all-weather roads. All hard-surfaced roads are to be not less than 18 feet wide except in unusual cases.

Recent Legal Decisions

RESOLUTION OF INTENTION TO IMPROVE STREETS HELD SUFFICIENT, THOUGH IRREGULAR

In an action in the Oklahoma courts by property owners to have certain special assessments levied against their property declared null and void, for the reason that the resolution passed by the city commissioners did not declare the work or improvement necessary, the proceedings were controlled by sections 722 and 733, Snyder's Statute of 1909, and it appeared that the city commissioners passed a resolution and published it the required length of time, as required by that statute; the resolution notified the property owners that, if no protest was filed within 15 days after the last publication of the resolution, a contract would be let for the paving and guttering of the street, and no protest was filed by the property owners. The Oklahoma Supreme Court holds, Oliver v. Pickett, 193 Pac. 526, that the resolution, though irregular in form, in not expressly declaring that the improvement was necessary, is not invalid, but sufficient to give the city commissioners jurisdiction to enter into a contract for the improvement, and the assessments made in accordance therewith are valid.

EMPLOYMENT OF ROAD COMMISSSIONER TO SUPERVISE CONSTRUCTION PROHIBITED BY STATUTE

The Arkansas Supreme Court holds, Hill v. Cruce, 225 S. W. 11, that Arkansas Acts, 1915, No. 383, par. 5, requiring from each commissioner of a road improvement district an oath that he will not be interested in any contract made by the board of commissioners, amounts to an express prohibition against his being so interested, and therefore renders invalid a commissioner's employment by the board to supervise road construction. The court considered that the trial court erred in holding a taxpayer not entitled to judgment against the commissioner so employed because it was shown that the contract was an advantageous one to the district. The Supreme Court holds that if the contract is illegal it is unimportant to determine whether it is advantageous or not, as its validity or invalidity is not determined by balancing its advantages against its disadvantages.

AWARD OF PAVING CONTRACT ON INCOMPLETE BID INVALID

In letting a county paving contract to the lowest bidder, under the Nebraska statute, Rev. St. 1913, § 2956, the specifications and proposals for bids called upon each bidder to specify the time when he will agree to commence and when he will complete the work, if awarded the contract, and provided that liquidated damages shall be charged against the contractor for each day's delay in performance beyond the contract time. The Nebraska Supreme Court holds, Root v. Douglas County, 180 N. W. 46, that in such a case the time of performance is an essential part of the bid, and, where omitted, the bid is in complete and not responsive to the proposal. In such event the bid cannot be filled out, nor the time for performance inserted, after it is received and opened by the county board, and an award of the contract to such bidder is invalid.

DISTINCTION BETWEEN URBAN AND INTERURBAN PASSENGER CAR TRAFFIC

The Wisconsin Supreme Court holds, in an action by a city to enjoin an electric railway and light company from carrying on its street railway system interurban passengers and freight, City of Milwaukee v. Milwaukee Electric Ry. & Light Co., 180 N. W. 339, that urban surface street car passenger service is the transportation of passengers in suitable cars over the streets of a city operated so as to permit them to enter and leave the cars at reasonable intervals. The initial point from which the car or passenger comes or the point to which they are destined is immaterial. The criterion is the character of the service rendered by the cars while on the city streets. If that is an ordinary or reasonable street car service as to fitness of car, rate of speed and frequency of stops for passengers to enter and leave, then while on the city streets such service is street car service, though the car may come from or enter interurban service on the same trip. It is also held that as to a given city interurban railway passenger traffic is the transportation between it and other cities or municipalities of passengers without thereby rendering reasonable or the prescribed street car service in such city. In interurban service the streets of the city are used for a purpose foreign to their dedication, by being transformed into a right of way for a commercial railroad which does not render reasonable street service.

WHERE COMPETITIVE BIDDERS REQUIRED TO FURNISH THEIR OWN SPECIFICATIONS FOR PAVING, ASSESSMENT AND CONTRACT ARE VOID

The town of Milwaukee, Ore., proceeded by ordinance under its charter to improve a street by grading and paving, payment to be derived only from assessments on adjacent property. Under the call for bids embodied in the second published notice it abandoned its established plans and specifications on which bids had been invited, and required each bidder to furnish his own specifications, so that the only competition between bidders was that of price. In an action by the lowest bidder to recover damages from the town for its failure to provide a fund to meet the contract price of the paving laid by the plaintiff, it was held, Montague-O'Reilly Co. v. Town of Milwaukee, Oregon Supreme Court, 193 Pac 824, that the proceeding was void and the con tract made with the lowest bidder gave it no cause of action. The nature and quality of the pavement to be laid vitally affected the question and should have been specified in advance. The question of sufficiency as to precision of the plans and specifications was not here involved. It was an instance of the total absence of authoritative plans and specifications.

NEWS OF THE SOCIETIES

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting. Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

April 1 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

April 14—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 15 — MERIDEN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — REGIONAL MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Atlanta, Birmingham, New Orleans sections. A. S. M. E. Council to attend. Mobile, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 27-29 — BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7—NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

AMERICAN ENGINEERING COUNCIL

The Committee on New York State Government Reorganization of the American Enginering Council of the Federated American Engineering Societies declares in reports to the chairman of the Joint Judiciary Committees of the Senate and Assembly that any corporation or business interest would go into bankruptcy if its affairs were conducted as are those of the state of New York.

The report, after a careful study of the whole problem, and particularly its engineering aspects, urged the passage of the three state reorganization amendments for consolidation of state departments, an executive budget system and a four-year term. Duplication and lapse of work, as also waste and delays due to lack of responsibility should be prevented. All work of a similar character should be under one department. Departments can be subdivided into bureaus to handle their work, but bureaus should not be duplicated. Departments of public works and of conservation would be most important divisions of the state government.

A large proportion of the expenses of the state are incurred for public works. It is absolutely necessary that work done should be grouped into departments. Both engineering and architectural functions should be grouped under the Department of Public Works where they can be systematically and efficiently managed without duplication and waste of public funds.

Great economies can be attained through the Departments of Public Works and of Conservation. If large enterprises are to be handled efficiently it is of vital importance to have one man in authority with respect to policy, finance, labor, materials and other controlling items, who can be reached without delay. To correct the evils caused by the present unsystematic methods, there is a strong demand for retrenchment, and to secure this result, a complete budget, prepared by the governor and embodying a plan of proposed expenditures, would be most effective.

PERSONNEL RESEARCH FEDERATION

Under the auspices of the National Research Council and Engineering Foundation, the Personnel Research Federation was organized March 15 to bring about interchange of research information among the 250 organizations that are engaged in personnel research in the United States. The Personnel Research Federation will collect research information, will encourage research through individuals and organizations and will co-ordinate research activities.

The temporary officers elected were: Chairman, Robert M. Yerkes, representing National Research Council; vice-chairman, Samuel Gompers, representing American Federation of Labor; treasurer Robert W. Bruere, representing Bureau of Industrial Research; secretary, Alfred D. Flinn, representing Engineering Foundation; acting director, Beardsley Ruml, assistant to the president of Carnegie Corporation of New York.

BROOKLYN ENGINEERS' CLUB

The informal library meeting on March 17 was devoted to a continuation of the "Discussion of the Brooklyn Transit Situation," led by Hon. Henry H. Curran, president of the Borough of Manhattan, and Hon. Herman A. Metz, former comptroller of the City of New York.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

A regular business meeting was held March 16 at the Engineering Societies Building.

"Streets and Parks of the Metropolitan District" were discussed by Charles Wellford Leavitt, landscape engineer, who introduced the subject, and by a number of other speakers. Among those invited to participate in the discussion were F. D. Gallatin, commissioner of parks, Borough of Manhattan; Jay Downer, engineer and secretary, Bronx Parkway Commission; Amos Schaeffer, consulting engineer, Borough of Manhattan; Frederick S. Greene, former commissioner of New York State Highways; Palmer Campbell, park commissioner, Hudson County, New Jersey; Charles Whiting Baker, member, Palisades Park Commission; Arnold W. Brunner, architect, president, Fine Arts Federation; George B. Ford, consultant to City Planning Commission, New York City.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY

This society at its convention in St. Paul on February 21-23 ratified the constitution of the proposed Minnesota Federation of Architectural and Engineering Societies and raised the dues to take care of this additional expense. It also endorsed the proposed registration law for architects and engineers.

ENGINEERING SOCIETY OF WISCONSIN

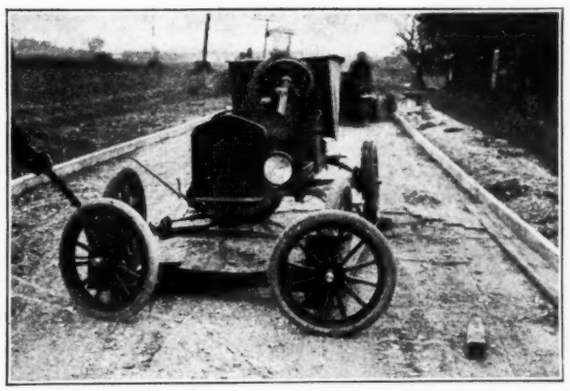
At its annual meeting in Madison on February 21-23, the Engineering Society of Wisconsin elected as president Prof. C. I. Corp, and as vice-president, Jerry Donohue. Resolutions were passed advocating that the state legislature compel the licensing of engineers, that a college of agriculture be established at the state university and that the St. Lawrence river be deepened for the use of ocean liners.

WISCONSIN STATE DRAINAGE ASSOCIATION

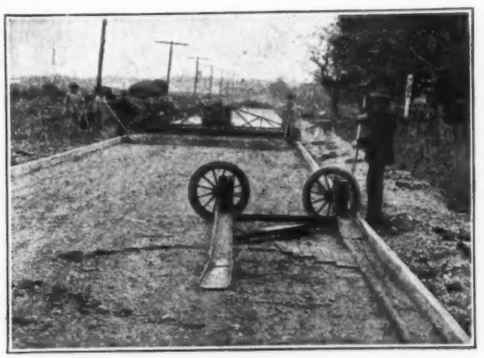
The Wisconsin State Drainage Association has elected the following officers: President, G. R. Hall; vice-president, Jerry Donohue; treasurer, Anton Brost; secretary, Prof. E. R. Jones; and assistant secretary, O. R. Zeasman.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



TRUCK BEING REVOLVED ON TURNTABLE



TURNTABLE INSTALLED ON SUB-GRADE

HUG TRUCK TURNTABLE

The Hug truck turntable, invented, adapted and manufactured by the Hug Lumber & Construction Company, is designed to turn trucks on the sub-grade of a highway between the concrete road forms. It is a light, portable apparatus built in two sizes for 1-ton Ford trucks or for 2 or 2½-ton trucks and can easily be shifted by two men as the work advances.

In operation, the truck is run onto the turntable till the truck wheels strike the bumper and one of the rear wheels, driving on the ground, revolves the turntable by the power of the truck engine. A loaded truck can thus be revolved 180 degrees in 8 seconds and the turntable switched back to original position by one man. It very much expedites the delivery of materials to the concrete power mixer and facilitates passage of trucks on the sub-grade, the turntable being placed at one side of the roadway to give clearance beyond it.

HOLT CATERPILLAR TRACTORS

Holt caterpillar tractors are made in 5-ton and in 10-ton sizes and have a draw-bar h. p. of 25 and 40, respectively, at a speed of 3 miles per hour. The weights are 9,400, 19,000 pounds and they are especially recommended for road work, particularly for hauling cranes or wheeled scrapers.

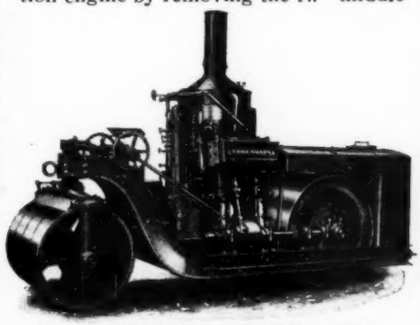
A 5-ton caterpillar tractor with three men will handle more dirt in one day than eight or ten good teams. It loads at a speed of 1.57 miles per hour, hauls the loading scraper at a speed of 3 miles per hour and returns the empty scrapers at a speed of 5.71 miles per hour.

A time schedule for a 5-ton machine hauling four 2-wheel scrapers 150 feet gives the trip time as 3 minutes and 5 seconds and the yardage as 390 in 8½ hours. Hauling one mile the trip time was 32 minutes and the yardage 38. These results included more than 15 per cent allowance for lost time.

One operator with two 5-ton caterpillars, six 2-wheel scrapers and four men handled an average of 400 yards per day to a distance of 12,000 feet.

MONARCH ROLLERS

The Good Roads Machinery Company, Inc. catalog of Monarch steam road rollers illustrates and describes the principal features of the 10 and 12-ton steam road rollers with two speeds, differential gear and high steam dome. They are provided with 48 detachable picks for use on worn stone roads and streets and with a belt wheel for operating a stone crusher. They can climb a 20 per cent grade and are efficient as traction engines. The roller is easily and quickly transformed to a traction engine by removing the tw middle front rolls, replacing them with a spreader, and adding traction cleats to the rear drivers. They can be equipped with a scarifier attachment having nine heavy manganese steel teeth that may be adjusted to any definite cuts of 1 to 6 inches.



ROAD ROLLER, SCRAPER AND TRACTOR

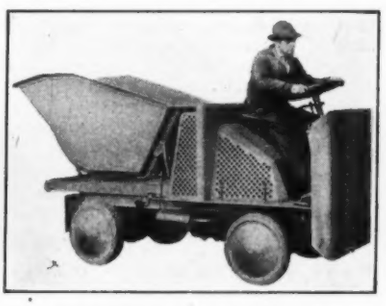
The Monarch tandem roller is built in 6-ton and 9-ton sizes, and has a steering device that consists of an oscilating steam engine by which the rear rollers can be set to the desired position before starting to roll.

MUSHROOM TRAFFIC LIGHT

Milwaukee Mushroom traffic light, manufactured by the Electrical & Specialty Company, is designed for installation in the pavement or roadway, and is provided with a very strong spherical segmental shield that deflects or supports front wheels without injury. It provides a signal that is easily visible by day or by night, that is unaffected by rain or snow, requires no replacement, and does not damage automobiles or jeopardize life or property. It eliminates the collision hazards of the old type stand signal.

POWEROX INDUSTRIAL TRACTOR

The Powerox, manufactured by the Barrett-Cravens Company, is a 4 x 8-foot tractor designed for heavy duty in factory or inter-plant service and for light to medium construction work where a very small unit is needed. If used as a carrier it will transport 3,000 pounds and as a tractor will pull 40,000 pounds. The engine clutch and transmission form a unit power plant located in front and with the radiator in its rear and power is applied to its rear wheels through a worm gear drive, rear axle fully enclosed. It has a front wheel steer and short wheel base, giving a very short turning radius. Many types of bodies can be supplied and information is given on demand.



TRACTOR AND CARRIER

STEEL ROAD FORMS

A 16-page booklet has just been published by the Lakewood Engineering Company, Cleveland, describing the Lakewood-Hotchkiss line of steel forms for road, sidewalk, curb, gutter, culvert, foundation and wall construction. It is profusely illustrated and shows the application of the Lakewood-Hotchkiss method of construction, which is claimed to secure better concrete and perfect expansion joints.

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INDUSTRIAL NOTES

ASH BARREL RETURNER

A push cart manufactured by J. T. Lynch for returning empty ash receptacles from the curb to the rear of premises has a curved frame work which will hold three of the largest sugar barrels in a row and three smaller barrels can be placed inside them. This returner has been loaded in service with eleven miscellaneous kinds of ash receptacles at one time. There were all shapes and sizes from regular barrels to wash tubs, baskets and boxes.

BARREL RETURNER CARRYING 7 RECEPTACLES

In cities where receptacles are not restricted there are about 14 different kinds of receptacles commonly used and 30 or 40 others used to some extent. This "returner" takes them all.

The illustration shows the returner loaded with 7 receptacles—2 barrels, 3 tubs and two baskets. One man can push it easily with one hand as it has rubber-tired wheels and can be pushed, when loaded, by one man with one hand. The two pilot wheels are needed only when loading the "returner" or in going down steps and terraces.

The iron frame is built of angle iron and the curved portions are well braced and rigid. It is 6½ feet long and weighs only about 50 pounds. The usual load is not over 70 or 80 pounds. One man with this returner can do the work of two men without it.

GIANT MINE CARS AND WHEELS

The 2-ton Giant mine cars made by the Judy Manufacturing Company are of all-steel, sturdy, compact, construction suitable for tunnel service and are mounted on Giant roller-bearing wheels of special type in which all of the moving parts are inside a grease chamber, reducing friction to a minimum and preventing waste of oil or grease. The solid roller bearings are dirt and waterproof and are held in position by a simple positive lock.

COAL TAR PRODUCTS

Lewis road tar and Lewis improved coal tar pitch filler, manufactured by the S. J. Lewis Manufacturing Company, are extensively used for road pavements in many places.

The specifications for Lewis road tar pitch require a specific gravity between 1.22 and 1.28, a melting point of not less than 100 degrees Fahrenheit, installation temperature of not less than 328 Fahrenheit and a carbon of not less than 12 per cent or more than 25 per cent.

CONWAY ASPHALTUM PRODUCTS

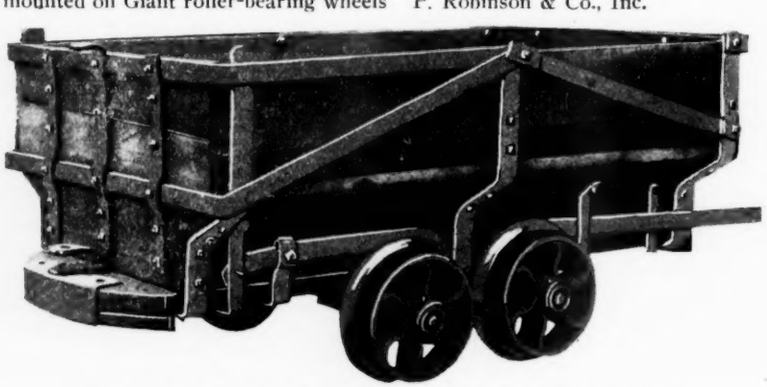
Asphaltum paint and products manufactured by the R. S. Conway Company, refiners and shippers of natural asphalt, are prepared to meet the requirements of road builders, pavers and builders and are offered for use as asphalt fillers for brick, creosoted block and granite pavements and for expansion joints, for penetration road work and for the preservation of wood and metal and for waterproofing concrete walls, cisterns, vats, pipes and other uses. They are extensively used in the city of Chicago and in many other municipalities.

CHICAGO INCINERATOR CO.

The Chicago Incinerator Co., erectors of the B. E. E. & Goeder incinerators and furnaces for low-grade fuel and factory waste, have removed their offices from 320 East North Water street to 2131 South Turner avenue, Chicago.

DWIGHT P. ROBINSON & CO. INC.

Dwight P. Robinson & Company, Incorporated, a large firm of engineers and constructors of New York, has recently opened branch offices in Montreal in the Dominion Express building. Alexander C. Barker, vice-president, is in charge of the office. The company is a consolidation of Westinghouse-Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc.



2-TON TUNNEL CAR WITH ROLLER BEARING WHEELS

PERSONALS

Philips, Hiram D., assistant division engineer of the Massachusetts State Department of Public Works, Bureau of Highways, has been appointed engineer of District 2, Franklin and Hampshire counties, Conn.

Scheible, Charles F., has been appointed Director of Public Service, Youngstown, Ohio.

Marks, Major Edwin H., is now in charge of the division of engineering in the area of Duluth.

Hoffeditz, W. L., paving engineer, of Twin Falls, Idaho, has been appointed city engineer of Colorado Springs, Colo.

Elder, Donald C., has been appointed engineer of Marshall county, Iowa.

Smithley, Charles, has been appointed engineer of Geary county, Kansas, to succeed G. A. Russell, who has resigned.

Tripp, Robert D., formerly city manager and engineer of Petosky, Mich., has been engaged as road engineer for Emmett county, Mich.

Reed, William B., of Weedsport, N. Y., has been named third deputy commissioner of highways with headquarters at Albany. He is succeeding Charles Van Amburg, of Binghamton.

Mieron, Frederick C., an engineer with the New Jersey State Highway Commission, died on January 19 at Lakewood, N. J.

Garvin, Samuel H., has been appointed city manager of Bowling Green, Ky.

Hambrecht, Albert L., was appointed State Division Engineer of Division No. 1, Wisconsin Highway Commission, with offices in Madison, to succeed W. C. Buetow, who is now at the main offices of the Highway Commission.

Mahnke, Edward, has been re-elected building commissioner of the city of Waterloo, Iowa.

Rogers, C. J., has been appointed county engineer of Jefferson county, Ala.

Lemmon, Major G. T., formerly resident engineer in charge of the work in 13 counties of the Virginia State Highway Commission, has been transferred to Richmond, where he will be in charge of 15 counties.

Eckart, Nelson A., has been appointed chief assistant city engineer of San Francisco, to succeed Mr. Cleary.

Boone, Louis C., of Rowesville, S. C., has been appointed engineer of Orangeburg county, S. C.

Owens, T., has been appointed city engineer of Port Angeles, Wash.

Barnard, Edward D., commissioner of the International Boundary Commission, died in Washington on February 6.

Fisher, James F., formerly engineer of Williamsport, Pa., died on February 5 at Muncie, Ind.

Taylor, Major Clyde V., has resigned from the United States Indian Irrigation Service with which he served for six years, and will engage in private engineering practice at Reno, Nevada.